The Builder.

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Building Disputes Five Centuries Ago, and Later.

IT is generally supposed that combinations and "strikes" on the part of workmen against masters or employers of labour are of very modern introduction. Without going back in search of precedents in early Greece and Rome, or other nations of antiquity, to prove that building and other workmen always had certain grievances to complain of, and adopted means for redressing them, we will confine our examples to our own country of five centuries ago, and later. History has been continually repeating itself for several centuries in the disputes between workmen and their masters. Sundry of the causes that led skilled workmen to revolt and leave their work several centuries since were similar to those that obtain in our own time, but the chief cause appears to have been always a desire of bettering their condition or increasing their pay. Masters in the Middle Ages in London, as well as in the nineteenth century, were prone to the practice of enticing good workmen from other masters for their own advantage; and building hands have withdrawn themselves from Government works without notice, to enter the employment of city and country masters. Although the old trade guilds enforced penalties against any master-workman found enticing another's hands, the practice nevertheless continued. Human nature in all ages has been much the same. A master finding himself short of hands, and busy, held out the inducement of higher wages or constant work for a stated period, and the workmen of old as well as their successors, were not slow to avail themselves of such offers. In the 27th year of Edward III. (1353) many building workmen and labourers who were retained or employed upon the works at the Palace of Westminster withdrew from their employment. The action of the workmen led to the issue of a royal mandate or proclamation, intended as a warning to the deserters, and those who employed them, of the penalties they incurred. The mandate speaks of the hands that had "been received to work for divers men of the city and county [Middlesex] aforesaid, within the same city and county, as we have been given to understand, in contempt of us, and to the damage and manifest retardation of our works aforesaid." After impressing upon the sheriffs of London and Middlesex their duty in causing the proclamation to be made far and wide, the royal mandate goes on to say: "that any one shall, on pain of imprisonment of his body at our will, and of grievous forfeiture unto ourselves, receive any such workmen upon his works, of whatsoever calling they may be, who shall have been before retained upon our works aforesaid (unless they shall have leave to depart therefrom), or in any way retain the same. And if, after the proclamation and prohibition aforesaid, you shall find any such workmen who have been before retained in our service, and have not had leave to depart therefrom, received upon the works of other persons of the city and county aforesaid, then you are to cause as well such workmen or their receivers to be taken, and the workmen to be brought back to our palace aforesaid, there to be set upon such our work; and the receiver of them to be sent to the Tower of London without delay, there in prison at our will to remain as before mentioned. And this you are in no way to omit." We do not learn in any subsequent civic records how far the sheriffs of London had been successful in their quest, how many deserters were brought back to the king's works, or if any builders in the city who acted as receivers had to go to expiate their offences in the Tower. The mandate of Edward III. was quite as severe against workmen as the Old Combination Laws, which were partially repealed in the 5th and 6th of George IV., and which Acts made it penal for workmen either to combine to raise their wages or to oppose their reduction. Of course at present (as for several years past) workmen may combine as much as they like to raise their wages or resist their reduction. Indeed, they may do much more by a system of strong moral suasion, or "picketing." So long as workmen do not use physical force they are within the pale of the law. The system of picketing is not altogether a modern practice, but the operation is mild compared with some of the physical manifestations in the earlier part of this century, even when the Combination Laws were in full force.

In the 30th year of Edward III. (1356), in consequence of the constant disputes occurring between the two classes of masons in the building trade, the hewers and the light masons or setters, it was found necessary to frame a number of "regulations" for the trade. At a meeting of the mayor and aldermen of the City twelve of the most skilful men of the Masons' Guild appeared to represent their respective branches, six on each side. The agreement come to appears very fair, considered with a view to the exclusive practices of the period. Among the "regulations" are the following:—"That no one shall work in gross [wholesale or by contract] if he be not of ability in a proper manner to complete such work, and he who wishes to undertake such work in gross shall come to the good man of whom he has taken such work to do, and complete, and shall bring with him six or four ancient men of his trade, sworn thereunto, if they are prepared to testify unto the good man of whom he has taken such work to do, that he is skilful and of ability to perform such work, and that if he shall fail to complete such work in due manner, or not be of ability to do the same, they themselves, who so testify that he is skilful and of ability to finish the work, are bound to complete the same work well and properly at their own charges, in such manner as he undertook, in case the employer who owns the work shall have fully paid the workman [meaning the contractor]. And if the employer shall then owe him anything, let him pay it to the persons who have so undertaken for him to complete such work." It is somewhat curious, after the lapse of five centuries, to find the old feud between the two sections of the masons' trade, the hewers and the light masons and setters, cropping up in our own time. Within the last quarter of a century in London there have been violent disputes between the masons who cut and dress the chief stones and moulded work, and those who lay the wall courses generally, as to whose right it was to set the stones or certain of them *in situ*. The claims of building and other workmen, particularly those of a peculiar and minor kind, have had to give way to the exigencies of modern building contracts. The terms of reconciliation of two master-masons who quarrelled in the City in the 26th of Edward I. (1298), and made use of certain abusive words, comes down to us in Latin in the civic records. These two worthies were respectively named Master Simon de Pabingham and Master Richard de Wetham. Of course they were reconciled as usual before the mayor and aldermen of the day, and the agreement was to the following effect:—That the said Simon and Richard did grant each for himself, that if either of them should be able to give information against each other, that he had by the same abusive words or in deed committed trespass against the other, and such person should, upon the faith of two trustworthy witnesses, be found guilty thereat, he should give 100s. towards the fabric of London Bridge, and they further agreed that in case such person

should not do so, the Chamberlain should cause the same amount to be levied, &c. Nearly five centuries and a half later on, in 1841, certain abusive words and alleged foul expletives on the part of a foreman mason at Westminster, when the new Houses of Parliament were building, led to a prolonged masons' strike, extending over six or seven months. The foreman, it appears, was somewhat exacting, if not tyrannical, and the workmen and himself could not agree. The masons employed in a body demanded his discharge, but the contractors, Messrs. Grissell & Peto, refused to comply with the masons' request; hence the strike. A series of circumstantial charges, some of a very grave character, were brought against the foreman, and eventually the accused replied to some of them through a letter in the *Times*. Several meetings were held by the workmen, and an inquiry was held into the truth of the charges advanced against the foreman, and the masons believed they proved their case. The masons' body withdrew their men from other contracts that were being carried out by Messrs. Grissell & Peto, and the work at the new Houses of Parliament, as well as elsewhere, was considerably retarded. In a statement made on behalf of the masons in April, 1842, when the strike had extended over the long period of thirty-two weeks, it was said that out of above 400 hands who had struck, 84 remained on the funds altogether, and only 32 of those who turned out at the Houses of Parliament and the Nelson Monument. A few weeks later all the turn-outs had found employment elsewhere. We may mention here that the Government, in consequence of the strike, enlarged for the contractors the time that the contract was to run. This strike of 1841 was small compared with the general London building strike of 1859, that eventually led to the adoption of the hour system, and the strike of 1872. Of these later disputes we do not intend to give any particulars, and we only cite that of 1841 for its historical relevancy to matters mentioned previously.

There were many disputes among building and other workmen in reference to trade matters in the fourteenth century, and the three following are of historical interest. In the reign of Edward II. there were disputes between the joiners and painters on the one hand, and the saddlers on the other, and in the 1st of Edward III. (1327) there was an agreement come to for the settlement of their feuds. Certain malpractices of the saddlers were alleged in the plaint of the joiners, painters, loriners in copper, and lorriners in iron. Large sums of money were said to be due by the saddlers to the other trades, which the former not only refused to pay, but, in addition to maltreating members of the latter trades, made use also of abusive language. The agreement, including the recital of the grievances on either side, is a lengthy document in Norman French. It is mentioned near the end of the agreement arrived at before the mayor and aldermen, "that these ordinances and grants shall hold good and be valid, as well against the saddlers aforesaid as the joiners, loriners, and painters before mentioned; they shall be enrolled in the hustings at London, for ever to endure, and also in the paper of the chamber of the Guildhall aforesaid." Alas! human laws and institutions are like the vanity of human wishes, often of a very short duration. Royal mandates, legislative enactments, and civic ordinances alike, are submerged by the rolling waves of time. The older the world grows the more difficult it becomes for statesmen to legislate safely even a half a century in advance of their time.

> "The falchion's blade may shiver,
> Stone walls in time will sever:
> 'Tis mind alone, worth steel and stone,
> Which makes men free for ever."

Of a verity it is, but the mind or knowledge that constitutes power must have truth for its foundation. Strikes, or disputes in trade leading to them, have not yet ceased; but our workmen and employers have grown more conscious of the magnitude of the evils that result from their operation. Mere disputes or differences of opinion will always, more or less, exist while the world lasts. In the industrial world men are learning, through the wisdom of experience, how to adjust their disputes by rational conferences, instead of resorting to methods that spell bankruptcy or ruin and beggary on either side. A strike *per se* may not be wrong, and there may be such a thing as a justifiable strike. Against ignorance, bad building and workmanship, let our masters and workmen strike amain, and education, health, and skilled labour will score a great victory for the nation.

THE STRAINS IN FRAMED STRUCTURES.

The work published under this title,* by a distinguished American engineer, is the most comprehensive treatise on the application of graphic and analytic statics to iron structures which we have yet met with, and must prove a most valuable text-book both to the civil engineer in designing metal structures, and to the student. Du Bois's works are already well known and appreciated. His definitions and axioms are always models of clearness and precision. It has evidently been to him a labour of love to make his present work as complete as possible. Almost every conceivable form of iron roof-truss is treated graphically in a series of plates sufficiently large to indicate clearly the construction of the force polygons; though to make use of them practically it will be found necessary to re-draw them to a much larger scale. The work is so complete for iron structures, and such a model of clearness and precision, that it is a pleasure to follow the author through the unavoidable intricacies of the subject. His definition of sheering force, and his deductions therefrom, are particularly worthy of attention, as this subject has proved a stumbling-block to so many writers. The author is indebted to Professor Alexander, of Japan, for his valuable solutions with reference to the maximum strains produced on girders by moving loads, to which we have already had occasion to draw attention; and to the experimental researches of Wöhler and Spangenberg for the effects produced by intermittent strains. In fact, all the most recent additions to our knowledge of the subject from every source are embodied in this work. The chapter on compound structures which involve the consideration of relative extensions is admirably written, although the theory of flexure may be open to criticism; and the excellence of the letter-press illustrations and general appearance of the work is on a par with the excellence of the subject-matter contained in it.

Notwithstanding the great excellence of this work, we must take exception to some of the principles advanced, and think it will be of great advantage to the student as well as to future writers on the subject to point out these matters, especially as the same errors exist in all works we have hitherto met with which treat on these particular subjects.

First, then, with respect to the braced arch or arched rib, continuous at the crown and under the influence of a pressure which depends upon its lateral strength to resist the stress, the author asserts "that the resultant pressures do not pass through the ends of the arch when they abut on the skewbacks, but that they are tangent to a hyperbolic arc within the arch and pass below the abutments." Assuming that the ends are buried in the masonry or otherwise rigidly secured in direction at these points,—that is, that the tangents there cannot rotate,—the thrusts might not, and, probably, would not, pass through the skewbacks, as the ends of the arch would then, to some extent, act as cantilevers; but in that case they would pass above, not below, the abutments as he shows them. In the following observations space will allow little more than to point out the principles involved, leaving much of the detail to be filled in by the intelligent reader, and care will be taken to avoid, as far as possible, intricate mathematical investigations. There are three methods of solution. Firstly, the directions of the thrusts may be determined as those which give the minimum amount of deflection to the arcs; secondly, they may be found by use of the theory of moments; and, thirdly, by considering the revolutions of the tangents combined with the theory of deflection. These three methods give precisely similar results. The last, which is here given, is, however, by far the simplest. First take the case where the arch is continuous at the crown and has its ends resting freely on the abutments.

Let A B C D, fig. 1, represent any uniformly

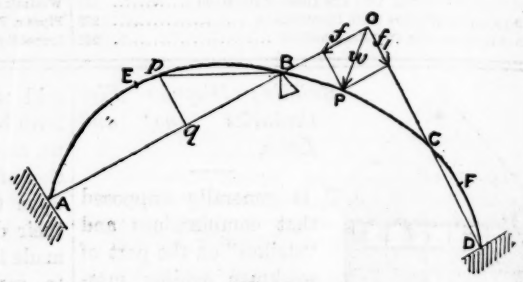


Fig. 1.

elastic curved lamina acted upon by a force w at P, with its ends resting freely on smooth surfaces at right angles to the directions of the thrusts, whatever those directions may be. The thrusts must necessarily pass through A and D and intersect on the line of force w, their magnitude being determined by the resolution of w in their respective directions. The general effect of the force is evidently to decrease the curvature at the crown B C, and increase the curvature at the flanks A B and C D. There are consequently two points, such as B and C, where the curvature remains unaltered. These are evidently the points where the thrusts f and f_1, passing through A and D, intersect the curved lamina, for the curvature necessarily alters if the force passes outside the lamina. In fact, the lamina might be cut at B and C perpendicularly to the direction of the thrusts without affecting the conditions; the arcs A B and C D acting as bent struts, the arc B C as a bent lever. The forces intersect the arc somewhat in the manner indicated in the figure. The tangents at the points A, B, C, and D rotate in opposite directions, taken consecutively. Hence there are certain points between A and B, B and C, and C and D, where the tangents remain constant in direction. First consider the bent strut A B acted upon by two equal and opposite forces along its chord; and suppose E to be the point where the tangent remains constant in direction with respect to the chord. Imagine the point E and its tangent to become fixed in position and direction, and the ends A and B to move in consequence of the deflections of the arcs E A and E B. It is evident the motions of A and B perpendicular to the chord must be equal in amount. Now the motion of B due to the deflection of any short length of arc $d\,s$ at p perpendicular to the chord p B $\sim d\,s \times p\,\mathrm{B} \times p\,q$; $p\,q$ being the distance of the force f from the point p. Therefore by similar triangles the motion perpendicular to A B $\sim d\,s \times p\,q \times \mathrm{B}\,q$. And the motion in the direction B A $\sim d\,s \times p\,q^2$. Or calling B A the axis of x and $p\,q$ the axis y, δ the total motion of B in the direction of the force in consequence of the deflection of every part of the arc E D, and δ_1 the corresponding total motion perpendicular to the force, and δ_2 the real deflection or the resultant of δ_1 and δ_2. Then

$$\delta \sim \int_x ds\, y^2$$

$$\delta_1 \sim \int_x ds\, xy$$

$$\delta_2 = \sqrt{\delta^2 + \delta_1^2}$$

Hence the amount of deflection in an arc in the

* The Strains in Framed Structures, with numerous practical Applications to Cranes, Bridges, Roof and Suspension Trusses, Braced Arches, Pivot and Draw Spans, Continuous Girders, &c. By A. G. Du Bois, C.E., Ph.D., Professor of Dynamic Engineering, Yale College, &c. New York: John Wiley & Sons. London: Trübner & Co. 1883.

direction of the straining force varies as the moment of inertia of the arc round the line of force.

From the above expressions, if the equation to the curve be known the deflections may generally be obtained analytically. But whatever the curve may be they may be found graphically, thus:—

Draw an equilinear polygon (fig. 2) to repre-

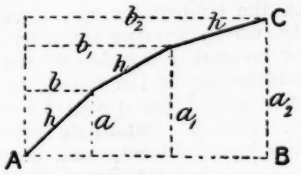


Fig. 2.

sent the curve; let h h h, &c., be the faces, a, a_1, a_2, &c., be the ordinates, b, b_1, b_2, &c., the abscissæ.

Then we may easily find that the motion of A in the direction of the straining force A B ~ moment of inertia of the polygonal line A C about A B, or

$$\sim \frac{h}{3}\,(2a^2+2a_1^2+2a_2^2+a_3^2+\ \ldots\ +aa_1+a_1a_2+a_2a_3+\ \ldots.)$$

And the motion of A perpendicular to A B

$$\sim \frac{h}{3}\left\{2ab+2a_1b_1+2a_2b_2+a_3b_3+\ \ldots\ \tfrac{1}{2}(ab_1+ba_2+a_1b_2+b_1a_2+a_2b_3+b_2a_3+\ \ldots.)\right\}$$

From this expression the positions of E and F may be determined.

Now the rotation of the tangent B through the deflection of the arc E B varies as its length multiplied by the distance of its centre of gravity from the straining force. Similarly for the rotation of the tangent at C due to the deflection of the arc F C. Since the tangents at E and F are constant in direction, the rotation of the tangent at B due to the deflection of the arc B P, by the force f, together with the rotation of the tangent at C, due to the deflection of P C, by the force f_1, must equal the sum of the rotations at the same points due to the deflection of the arcs E B and F C by the same forces f and f_1. This equation is independent of any rotation that there may be in the tangent at P. The sum of the rotations of the tangents at B and C of the arcs P B and P C are measured similarly by their lengths, times the forces, times their distances from the centres of gravity of the arcs. A simpler equation may be deduced from the following corollaries:—

If there be no relative rotation of the tangents at the ends of an arc (as E and P) the force deflecting it passes through its centre of gravity.

But if the tangents at the ends have a relative rotation the magnitude of the rotation varies as the length of the arc, distance of its centre of gravity from the force, and magnitude of the force. Thus (fig. 1),

Arc E P $\times$ f $\times$ distance of f from centre of gravity of E P = arc F P $\times$ f_1 $\times$ distance of f_1 from centre of gravity of F P.

These are the general principles which determine the direction of the thrusts when the ends are free to slide on abutments perpendicular to the thrusts. The application of these principles to curves whose equations are known is generally not very difficult. In circular arcs the equations involving the deflections for the determination of the points E and F are unnecessary, as those points are situated half way between A B and C D.

Thus if the arc A B C D be circular and support a weight at the crown, arc A B is equal to arc C D, E and F bisect arcs A B and C D, and the thrusts pass through the centres of gravity of E P and F P. The stress may sometimes be in such a position and direction that one or other of the resultant thrusts does not intersect the curve. In such a case the curve should be extended so as to intersect the line of thrust. The above principles can then be applied.

When the ends of the arch are pivoted at A and D, instead of being allowed to slide freely on the abutments, other strains are usually produced. The increase to the length of the chord B C through the deflection of the arc may be equal to, greater than, or less than, the increase in the distance between B and C, due to their motions towards A and D, caused by the deflection of the arcs A B and D C. If the increase be greater or less than the distance, the points B and C are no longer fixed points in the arch, but approach or recede so as to make up the difference. These differences can be easily estimated in any case by the laws of deflection of curved arcs already explained. The thrusts also will sometimes rotate to some extent round the pivoting points in consequence of a greater amount of deflection on one side of the arch than on the other. These rotations may also be easily ascertained for any special case by the same laws. Generally speaking, it is unnecessary to estimate the secondary strains, but in cases where the rise of the arch is relatively small in proportion to the span, it is sometimes necessary to take them into account.

If the ends of the elastic lamina be fixed in direction so that the tangents at A and K cannot rotate, the thrusts pass somewhat in the manner shown in the diagram (fig. 3). To elimi-

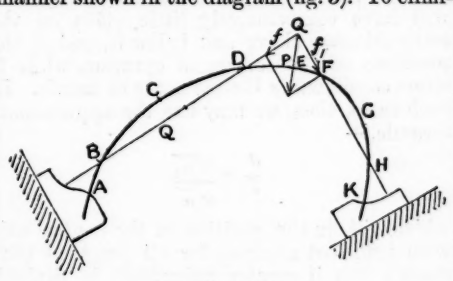


Fig. 3.

nate the secondary strains, suppose the ends be let into blocks which slide freely on surfaces at right angles to the directions of the thrusts. There are five points, A, C, E, G, and K, where the tangents do not rotate. The deflection of A B causes the tangent at B to rotate in the same direction and to the same extent as does the deflection of B C. Therefore, the thrust passes through the centre of gravity of the arc A C, and it cuts the curve at such a point, D, that the deflection of the arcs B C and C D perpendicular to B D are equal. It also passes at such a distance, d, from the centre of gravity of the arc C P that C P $\times$ d $\times$ f = G P $\times$ d_1 $\times$ f_1, d_1 being the distance of the thrust f from the centre of gravity of the arc G P. The centres of gravity of the arcs C P and G P falling always on the same side of the corresponding thrusts.

These are the general principles which determine the directions of the thrusts when the ends are fixed. When the curve is irregular, mathematical expressions cannot be obtained, though the graphic solutions are always sufficiently simple. The centre of gravity of any curved line may be determined with sufficient accuracy by dividing it into a number of small arcs which differ insensibly from their chords, choosing any convenient power of 2 to represent their number, as 4, 8, 16, 32, &c., and combining them together in groups, first of 2, secondly of 4, thirdly of 8, &c. The same divisions of the arc will give its length with sufficient accuracy.

Thus, to find the resultant thrusts in any curved rib whose feet are fixed in direction. Assume such directions as appear reasonable, meeting in the line of the straining force. Find the positions of C and G (fig. 3) so that f passes through the centre of gravity of the arc A C and f_1 of the arc K G. The point of intersection D should be so situated that the deflection of the arc C D is equal to the deflection of the arc B C, perpendicular to the force. If it do not satisfy these conditions alter its direction so as to do so. So also with regard to f_1; and finally, if δ and δ_1 be the distances of the thrusts f and f_1, from the centres of gravity of the arcs C P and G P,

f $\times$ arc C P $\times$ δ must equal f_1 $\times$ G P $\times$ δ_1.

When the arc is a known curve, as the ellipse, parabola, or catenary, the formulæ, though complex, may be mathematically expressed. The circular arc is very simple. Thus, if a circular arc support a weight at its crown, the thrusts pass through the centres of gravity of the arcs A P and K P, parallel to their chords.

When the ends A and K are not allowed to slide freely on surfaces perpendicular to the thrusts, secondary strains are introduced, as in the former case, when the ends are carried on fixed pivots. These strains should sometimes be taken into account. Heat strains are of a precisely similar nature, and may be determined on the same principles.

Another error of principle which is common to this and other works is the assumption that the neutral axis of a beam under transverse strain passes through the centre of gravity of the cross section. This assumption is correct only when the horizontal line through the centre of gravity divides the section symmetrically; it is inaccurate when the line does not do so, but passes closer to the bottom or to the top. Neither is it correct to assume that the moments of inertia of the sections above and below the centre of gravity represent always the moments of resistance. Where the neutral axis is not at the half depth the matter at the further extremity from it is strained up to its elastic limit before the matter at the nearer is so affected. The moments of inertia require, therefore, to be divided by the greatest distance of any part of the cross section from the neutral axis before they properly represent the moments of resistance to deflection. The position of the neutral axis may be determined analytically in many cases. In the familiar example of a bar of triangular section, Du Bois, in common with others, assumes that the neutral axis passes through the centre of gravity of the section, *i.e.*, at $\frac{2}{3}$ the depth from the apex. Now, the strain at any depth is proportional to the horizontal diameter there and to its distance from the neutral axis. Therefore the moment of resistance round the axis is *proportional* to the diameter multiplied by the square of its distance from the neutral axis. Hence the sum of the moments of resistance above and below the axis are *proportional* to the moments of inertia of the areas above and below. Therefore the neutral axis must be in such a position that the moments of inertia of the sectional areas on each side of it may be equal; not the moments of weight, as would be the case if the neutral axis passed through the centre of gravity. In the example before us (fig. 4) let the angle at the apex be 90. Let a be

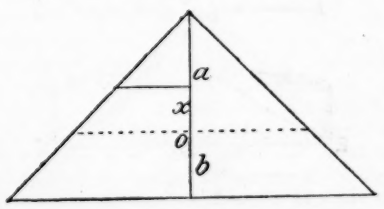


Fig. 4.

the distance of the neutral axis from the apex, and b its distance from the base. Take o as the origin, and let x represent any vertical distance from o. Then for the moment of inertia m of the area above the axis—

$$m = \int_a^o 2\,(a-x)\,x^2dx = \frac{2a\,x^3}{3} - \frac{x^4}{2} = \frac{a^4}{6}$$

For the moment of inertia m_1 of the area below the axis—

$$m_1 = \int_b^o 2\,(a+x)\,x^2dx = \frac{2a\,b^3}{3} + \frac{b^4}{2}$$

$$\therefore\ 4\,ab^3 + 3b^4 = a^4$$

If therefore $b=1$, $4a+3=a^4$, and $a=1{\cdot}7844$ instead of 2 as usually assumed, in this instance there is an error of $12\frac{1}{2}$ per cent. in excess of the elastic strength.

Although the moments of resistance vary as the moments of inertia, the latter require to be divided by the maximum distance of any of the matter in the cross-section, and multiplied by the elastic strength per unit of area to represent completely the moments of resis-

tance. In many sectional forms the error resulting from taking the neutral axis through the centre of gravity is much greater than in the example given above; as, for instance, in inverted ⊥ sections where the rib is of small depth in proportion to the width of the flange.

Let b (fig. 5) be the thickness and d the depth of

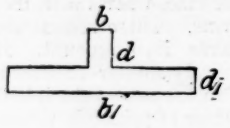


Fig. 5.

the rib, and b_1 the breadth and d_1 the depth of the flange. And suppose the proportions are such that the neutral axis is at the depth d, in which case $bd^3 = b_1 d_1^3$. So if $b=1$, $d=2$, and $d_1=1$, then $b_1=8$, and if c be the limit of elastic resistance per unit, the moment of resistance of the section would be $2\frac{1}{3}c$. Now the centre of gravity of the cross section may easily be found to be 2·2 from the top or ·8 from the bottom, and the usual method of calculating elastic strength, taking the bottom flange as our guide, would give $3\frac{1}{3}c$ as the moment of resistance; an error of 43 per cent.

The determination of the neutral axis, without which there is no possibility of calculating accurately the elastic strength of a beam whose section is not symmetrical about a horizontal axis, is always a difficult matter if treated analytically, except in some few instances, such as the triangular section we have given above, though nearly always possible when the sections are bounded by curves whose equations are known. Its position may, however, always be found graphically with sufficient accuracy for all practical purposes, however irregular the sectional form may be. The following method is of universal application, though we have chosen a common form as a useful example to illustrate its application.

Assume any approximate position for the neutral axis, such as AB (fig. 6). Draw two lines

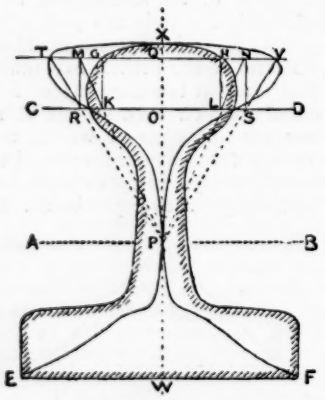


Fig. 6.

CD and EF parallel to AB, and at equal distances from it; EF may for convenience coincide with the base of the figure, as shown; or CD with the summit. From the extremities of any diameter GH parallel to the axis AB draw perpendiculars to CD.

Through the points of intersection KL draw line to any point P in AB, intersecting GH produced at M and N. P may for choice be taken in the vertical axis when there is one. From M and N draw perpendiculars R and S, and radial lines from P through R and S cutting GH produced at T and V. Let $PO=d$, $PQ=x$, $QG=y$, $QT=y_1$. Then from similar triangles,

$$\frac{QM}{y} = \frac{x}{d} \qquad \frac{QT}{QM} = \frac{x}{d} \qquad \therefore QT = \frac{x^2 y}{d^2}$$

$$\text{or } Q\,T\,d^2 = y\,x^2$$

That is, the moment of inertia of GQ round the axis AB is equal to $TQ \times OP^2$. By repeating the construction for a sufficient number of diameters parallel to AB, and joining the ends corresponding to T.V., a curve will be formed enclosing an area a_1, which, multiplied by the square of the length, $PO(d_1)$, is equal to the moment of inertia of the sectional area a of the beam above the axis AB. Proceeding in the same way with the section below the axis, we find an area a_1, which, when multiplied by the square of PW, or its equal, $PO(d_1)$, is equal to the moment of inertia of the sectional area a below the axis. If these two areas prove to be equal, the position of the neutral axis has been happily chosen; if not, an expression may be found to correct the position of the axis.

Since the moment of inertia of area $a = a_1 \times d_1$ the centre of moments of inertia of the area or the distance d of its centre of gyration from its axis can be ascertained from the equation $ad^2 = a_1 d_1^2$.

$$d = d_1 \frac{\sqrt{a_1}}{\sqrt{a}}$$

Similarly, for the area below the axis,

$$\delta = \delta_1 \frac{\sqrt{a_1}}{\sqrt{a}}$$

and ad^2 should equal $a\delta^2$.

In sections of beams where the principal part of the area is concentrated in the flanges, an alteration in the position of the neutral axis will have comparatively little effect on the sectional areas above and below it, and on the positions of the centres of gyration, while it alters considerably the moments of inertia. In such cases, then, we may use the approximate formula,—

$$\frac{d}{\delta} = \frac{\sqrt{a_1}}{\sqrt{a}}$$

which will fix the position of the neutral axis with sufficient accuracy for all practical purposes; but if greater refinement is desired, the process may be repeated with very little trouble. The areas a and a multiplied by the square of the distance d, and the constant c for the elastic strength of the matter, and divided by the maximum depth, PX or D of any part of the section of the beam from the neutral axis, gives the moments of resistance of the beam to deflection, thus :—

$$m = \frac{a_1 d_1^2 c}{D_1} + \frac{a_1 d_1^2 c}{D_1} = \frac{2\,a_1 d_1^2 c}{D_1}$$

$$\text{or} = \frac{2\,a_1 d_1^2 c}{D_1}\, a_1$$

Or we may take the expression,—

$$m = \frac{a d^2 c}{D_1} + \frac{a \delta^2 c}{D_1}$$

If the line C D had been taken at the summit of the section, or $D_1 = d_1$, the moments of resistance would be

$$m = 2a_1\, D_1\, C.$$

But then the area a_1 would frequently be found too small for accurate measurement. It is better to take the position of C D as in the figure, so as to produce a larger area for a_1 than for a.

The areas of the figures may be estimated with sufficient accuracy by forming them into triangles, with give-and-take lines for the curves.

It may be here noticed that a similar method may be employed to obtain the centre of gravity of any figure. For the area a_2 of the curve formed by joining intermediate points such as M and N multiplied by the distance PO or d_1 is equal to the sectional area a multiplied by the distance d_2 of its centre of gravity from the axis, or

$$a d_2 = a_2 d_1$$

$$\therefore d_2 = d_1 \frac{a_2}{a_1}$$

When the area is not symmetrical about an axis it is necessary to find the distance of the centre of gravity from two lines in order to fix its position completely.

Cantor Lectures.—Owing to the unusual pressure of matter this week, we are compelled to defer our report of the first of Mr. Edis's Cantor lectures on "Town Houses" till next week, when reports of the first two lectures will appear together.

NOTES.

M. Edmond Guillaume has been appointed to the post of Professor of the Theory of Architecture in the École Nationale des Beaux-Arts of France, in place of the late M. Lesueur. The duties of the office comprise, besides giving general supervision to the course of instruction in architecture, the responsibility of giving the subjects of all the competitions in which the students engage, which amount to thirty-two in number annually, and the Professor becomes a member of the Council of Administration of the school, and of the juries who award the prizes for the competitions. Like his immediate predecessors, MM. Vaudoyer, Blouet, and Lesueur, M. Guillaume is also a member of the Académie des Beaux-Arts. The appointment of M. Guillaume to the professorship was expected, in spite of a considerable rivalry on the part of other competent candidates, owing to his special claims to such a post. Besides having been the author of various much-admired executed works, he was early distinguished as a student, having gained the "Grand Prix de Rome" in 1856, and signalised himself by an important restoration of the theatre of Verona; and he was associated with M. Perrot, then a pupil of the École Française d'Athènes, in the work on the archæology of Galatia and Bithynia, the illustrations of which were largely based on his studies. He was also associated with MM. Daremberg and Saglio in their valuable Dictionary of Greek and Roman Art. M. Guillaume is a member of the Société Centrale des Architectes and of the Société des Antiquaries de France, and is also a Chevalier of the Legion of Honour.

The ninth annual return of the Cabmen's Shelter Fund reports thirty-three of such shelters now in use. The initial cost of each shelter is from 140*l.* to 170*l.*, but as they are made so as to be portable, the construction is such as to require frequent repairs, which keep up a considerable chronic expenditure. The committee desire eventually to provide all the recognised cab-ranks (about 120 in number) with a similar shelter. Some of the larger cabstands are likely to be permanent institutions in the same quarter for so long a period that it might be worth while, we should suppose, to build a more permanent structure which would not require so much repair. Something in the nature of Mr. Lascelles's cement slab cottages might come in well for this purpose. The committee require more funds to carry on their work, and we hope they will obtain them. The cabmen are a very useful class of public servants, leading hard lives, and certainly not overpaid, and they well merit the kind of assistance which the committee are endeavouring to promote.

The very useful and practical paper on Electric Lighting, read at the Institute of Architects last Monday, by Mr. Killingworth Hedges, appears to us to suggest conclusions different from those which the author of the paper wished us to draw in regard to the superior safety of electricity as a means of lighting. Mr. Hedges mentions that no fire from this cause was reported in London in 1882, only one in 1883; but then how comparatively limited is the use of the light in London as yet. On the other hand, he tells us of fifteen fires in one district in America, where electric lighting was largely used in mills, and some of these were caused by such circumstances as dust settling on uninsulated wires, which, on a damp day, absorbed enough moisture to set up a cross arc; in another instance damp brickwork in a tunnel became a sufficient conductor to set up a cross arc which "did no damage," apparently only because there was nothing in such a situation which it could damage very well. Bad contact between a wire and a terminal may induce heat; and if we consider the millions of such points of contact which would exist, were London entirely lighted by electricity, this must be taken as a very serious source of danger. It is very well to talk of gas as a

"lurking volcano," but gas at all events warns us unmistakably of its escape by its smell, whereas there is no warning of the escape of electricity into wrong channels, save through the diminished brilliancy of the light; this may, in some cases, be very slight, and how many people of average intelligence,—servants in houses, especially,—would be likely to give due and immediate heed to this? We certainly should not think that Mr. Hedges's paper would be likely to have the effect which he suggests, of inducing insurance companies to lower the premiums on all buildings from which gas is excluded, regarding electricity as the alternative. On the whole, we should regard it as fortunate that the mechanical and commercial difficulties in the way of general lighting by electricity are likely to postpone its adoption until we have had time to develop more complete means of controlling this powerful agency, which it is proposed to domesticate among us.

THE closing-up from view, for some time past, of Hardwick's colossal Doric portico of the London and North-Western Railway by the new hotel buildings which have been extended in front of it, takes away from the approach to the station a certain grandeur and effectiveness which this massive work imparted to it. Very trivial are the small burrows under the hotel, with their neat columns, in comparison. It is now rumoured that further alterations may necessitate the removal of the portico from its present position altogether. If so, we hope it may be set up again in some important position where it will have a meaning. It is true that the lintels are a terrible sham, being cramped together owing to the impossibility of getting homogeneous masses of stone to bear over the large openings. But the scale and style of the portico showed at least this, that its architect appreciated the fact that this was the access to a great system of travelling roads, the importance of which to the country could hardly be over-rated; and he determined that it should have a gateway commensurate in scale and mass. Something less rigid than a Doric order might have been more manageable; but it was, at any rate, the attempt to do something large and dignified purely for the sake of largeness and dignity,—an attempt we seldom see made now in such matters.

THE Royal Institute of Painters in Water-Colours, at a general meeting of members summoned on Wednesday last, in consequence of the resignation of Mr. Louis Haghe, who has for many years been president of the Society, elected Mr. J. D. Linton as their president. They could hardly have done otherwise, for in the highest branch of painting, that which deals with the figure, Mr. Linton is *facile princeps* in their ranks, and for some time past his remarkable drawings were among the few which kept alive the interest of the exhibitions of the Institute during the latter years of its sojourn in the old quarters in Pall Mall. We have felt regret, however, that in some of Mr. Linton's later productions the element of executive power was more predominant than that interest and pathetic power, in regard to subject and treatment, which characterised some of his earlier works. We venture to hope he will keep in mind what he used to lead us to expect from him in this respect.

LAST week the distribution of prizes in the Liverpool Government School of Art took place, being the first public gathering in the new premises in Mount-street. From the report of the meeting in a local paper, the school seems to be in an active and flourishing condition; it possesses in Mr. Finnie an able and competent head-master. Part of the report of the proceedings, however, again suggests what we have commented on before in regard to the Government Schools of Art in this country,—the broad-cast manner in which prizes and certificates are thrown about. From the report we gather that the average number of students presenting themselves for examination in the "second grade" is about 230, or a little over; and we see about forty names of recipients of "second grade prizes," and over 120 of "second grade certificates." At this rate it will soon become the most distinctive result *not* to have obtained a prize.

As the work at Peterborough proceeds, the necessity for thoroughly investigating and making good the foundations of other portions besides those at first threatened, becomes apparent, and the walls and staircases of the transepts are showing signs of the insufficient and treacherous character of their footings. These and other similar discoveries in Mediæval buildings are interesting, as showing how little connexion there may sometimes be between architectural genius and aspiration in the artistic direction, and practical knowledge and perception of the conditions of sound building. In this respect it would seem that we want the thirteenth and the nineteenth centuries rolled into one. The Mediæval builders erected beautiful and poetic fabrics, which were almost literally in many cases houses built on sand, and stood by a kind of interposition of Providence. We can now make first-rate foundations, which would be immovable for centuries, but alas! we have little worth putting on them.

WE commend to the attention of architects and those who are desirous to employ the services of architects in building residences for beauty as well as for fitness, the glowing list of various-coloured marbles available for the artist-architect which is tabulated in the portion of Mr. Aitchison's Royal Academy Lecture which we print elsewhere. Constructive polychromy is the most satisfactory of all to the architectural mind, since it is the most durable, and it is built up, instead of being laid on, in a manner in harmony with the whole ideal of what architecture is,—a construction of solid materials, put together so as to combine into one design. We do not wonder that Mr. Aitchison, having familiarised himself specially with the beautiful and various founts of colour which marble supplies, should grow eloquent on the subject. We heartily wish his feelings may find a practical response among some of those who might, could, and should glorify their structures with colour, and are content to leave them as cold and grey as Mr. Ruskin's sky of the nineteenth century.

ON Tuesday, the 19th inst., the third night of the debate on Mr. Conder's paper on "Speed on Canals" was occupied by a very lively discussion. Twenty-two speakers have taken part in the three debates, and the interest excited has been sustained and very great. In addition to the central subject of the paper, the scientific relations that obtain between the size and form of water-way, the size and form of vessels, and the attainable speed, much information was contributed by several speakers as to the state, the capacity, and the cost of the Suez Canal,—the latter having expanded from the original estimate of 64,800*l.* per mile, to the cost, to the end of 1882, of 143,500*l.* per mile for works, and 56,500*l.* per mile for management, finance, and interest paid out of capital. So much anxiety was shown to address the Institution that the utmost time available was exhausted, and Mr. Conder was thus prevented from giving his reply upon the whole case, which he will do in the usual mode through the secretary. The paper and debate, illustrated by drawings and diagrams, will appear in vol. lxxvi. of the Proceedings of the Institution.

Birmingham Architectural Association.—An ordinary meeting of this Association was held at Queen's College on Tuesday, the 12th inst., under the presidency of Mr. J. Cotton. Messrs. W. Hawley Lloyd and W. Tadman Foulkes were elected honorary members, and one other gentleman was proposed for membership. A paper was read by Mr. J. Spencer Swann on "The Influence of Literature on Art." A discussion and a vote of thanks followed, in which Messrs. H. H. M'Connal, V. Scruton, T. W. F. Newton, and Franklin Cross, hon. sec., joined.

FOUR NORMANDY TOWNS.

ONE of the greatest of our historians of the present day tells us that the Englishman feels nowhere so much at home on the Continent as in Normandy. Apart from the near kinship which we bear our neighbours of the North of France, apart from the similarity of the *Jacques Bonhomme* of those parts with the English peasant of Hampshire, Sussex, and Kent, the towns of Normandy have something particularly attractive to Englishmen. Long ere he visits them does the English traveller read of them when a boy in his history-book; long ere he assails their "sights" with his guide-book, has he helped in imagination to besiege them with Richard the Lion-hearted, to incite them to revolt with the perfidious Philip Augustus, or to enter them in triumph with the terrible Conqueror, William. He may still, out of the love he bears to his history-book, visit them with delight, and if the historical reminiscences of his youth have been eliminated by the graver studies of maturity, he will not only see many things which will bring back to his recollection the years when he lived in the Middle Ages, but will be compensated by the contemplation of some of the most splendid specimens of art and architecture in France.

The beautiful town of Rouen is in truth only three quarters French,—at least, speaking historically; but the period in which the English relationship to Rouen stands out most prominently reflects little credit on us, for the principal thing connected with the English name at that time is the death of Joan of Arc. Her statue stands in one of the open spaces of the town, by no means a beautiful piece of work; indeed, had the Maid of Orleans been as unprepossessing as she is represented there, she would never have been permitted to take Orleans, and the Bishop of Beauvais would certainly not have had the courage to burn her. Close by is the Hôtel du Bourgthéroude, an elegant house, or rather, palace, in the older part of which Joan of Arc was said to have been condemned to death. The later portions of this charming edifice are built round a court-yard, and three of the walls are most beautifully decorated with stone carving, representing the pageant of the Field of the Cloth of Gold. But alas! French spirit is as good at destroying as it is at creating, and the enthusiasts of the Revolution knocked off everything that related to royalty; the wreath of flowers is left, but the arms of the kings contained in it are gone; the cushion and stool are there, but the crown has been removed; the monarchs themselves are still to be seen on horseback, but they now will be recognised, not by their crowns, but by their being without their heads. In such a city as Rouen it is difficult to know which of the many beauties to review first, the Cathedral or the Museum, the Courts of Justice or the Church of St. Ouen, the Seine and its ships or the Hill of St. Catherine, the various little minor beauties or the town itself, a magnificent whole, as it lies nooked in a valley between a semicircle of hills and a bend of the Seine. To discuss each separately our limited space does not permit, so we must confine ourselves to those objects that leave behind them the most marked impressions. There are few European buildings that so impress the mind as the Cathedral. Drawn to it as by magnetism, by the beauty of its towers, which peep over the gabled roofs of the houses at all the most picturesque turns of the streets, apparently grouped on purpose for artists, we suddenly come upon the façade, one broad mass of sculpture and windows, with one grand central and two side portals of exquisite workmanship; while on the sides of the edifice are the two charming towers that harmonise in their irregularity,—one of these, so runs the tradition, being called the Tower of Butter, because built by the pennies which the priests ingeniously got from the people for permission to butter their bread in Lent. Be that as it may, and if nowadays we build our works on firmer foundations than those of butter, certain it is that to religious enthusiasm and an ennobling love for religious beauty, the town of Rouen,—nay, the whole of Mediæval France,—owes its grandest architecture. It would be difficult to find in another town of equal magnitude two such edifices as the Cathedral, and the Church of St. Ouen. By many the latter is preferred for its greater completeness and perfectness, its harmonious lightness and grace, to the more ponderous and varied grandeur of the

Cathedral; but as to the greater conception belongs the greater praise, so does the human genius, represented in so many architects and artists which produced the Cathedral, claim for that edifice a greater amount of veneration, if not of praise, than does the human genius which gave birth to the more consummate, though less imposing Church of St. Ouen. Scarcely inferior to St. Ouen is St. Maclou, whose gorgeous triple porch rises out of the dingy streets, more like the visionary creation in the mind of an architect, than a cold reality of stone and carving in the gloom of a Norman town—more like the fretted portal of the fane a poet might conceive in which to marry his heroine, than the lordly entrance unnoticed by the prosy priest, as he shuffles under it every morning to drone through his masses.

Parting from the lovely churches, there is still much to be seen that no description can do justice to,—much of which no idea can be formed till actually visited and studied. No one who carries away with him an airy, mental vision of the Palais de Justice would unhesitatingly offer himself as an able and accurate describer of the beauty of that edifice, or dare to translate his impressions to paper. He would confess that as a piece of Norman Gothic it was certainly one of the most beautiful specimens of its kind; he would pronounce its carvings and frettings to be perfect in their airiness and delicacy; he would perhaps venture a few commonplace remarks on the softness of its shading and the grace of its proportions; and he would, no doubt, unwind many other little humdrum conventionalities of description, which to the unknowing reader might convey a very favourable impression as to the style of his writing, but not the very faintest impression of the beauty of the building he was writing about. Though the same does not exactly hold good with the other sights of Rouen, there are many things that a network of words and epithets can describe but with difficulty; portions of Rouen, like the Rue de l'Épicerie and Rue de la grosse Horloge, are not so difficult to conjure up, either mentally or verbally, as the Palais de Justice. Let the reader imagine before him the picture of a street, narrow and slightly curved; to the foreground are old gloomy houses, made of all conceivable things, that tend to add picturesqueness; coloured beams, ornamented signboards, patches of cement here, and portions of brick there, gabled roofs with little bits of ironwork on the top, rows of half-opened and partially-curtained windows, red tiles on the roofs, and old carved doorways, opening to a rickety street paved with cobble-stones and alive with the traffic of a market-day or a fête; then let him conceive a sudden burst of sunshine in the background at the end of the street, lighting up one of the side portals of the cathedral, which rises to the top of his picture, and looks like a fairy creation of pure white marble, curtained on either side with the quaint extravagances of Mediæval house architecture, and he has before him the Rue de l'Épicerie, the humble habitation of the grocers of Rouen. Let him imagine another picture, this time a double one, that is to say, a picture painted on both sides; each represents a street winding beneath a quaint and graceful archway, vaguely suggestive of our own Temple Bar. The archway on the one side is gloomy and shaded, while the sun shines brilliantly on the white and varied houses, discernible through the entrance, and behind the painted traffic of vehicles and passers-by. Then let him reverse the picture: all the sun-dazzle is on the face of the arched clock-tower, lighting up the golden hands of a huge time-piece in the centre, and catching the sparkles of water that flow from a pretty fountain, wrought in stone bas-relief, on the right-hand side of the archway; Alpheus at the stream head, with his urn, and Arethusa below. They are no more chasing, but now,—

> "Like friends once parted,
> Grown single-hearted,
> They ply their watery tasks,"—

and, though a little grimed with age, still, when the sun shines on them, as delightful as ever, and of more service, no doubt, in giving water to the gossips of the Rue de la grosse Horloge, than they ever were on the Acroceraunian Mountains. But lingering in Rouen means lingering a very long time, and the Alpheus of space pursues, so that we must hasten to the Seine to take our last look of the fair town. A very good point lies a little higher up on one of the bends of the river. We catch the city sideways; the Seine, coiling along in front among the willows, "rolls her watery labyrinth" around the town; masts and sails of ships are mingled among the trees; before us is a row of hills, on one of which stands the Church of Notre Dame de Bon Secours; the hills stretch around the city and seem to bear it gently cushioned in a green bed, defending its stately spires from harm, and when evening comes, charming down the valley mists that slowly curtain it from our sight.

From Rouen to Caen is a step downwards in the ladder of beauty; but Caen is one of the representative towns of Normandy, and so shares, in proportion to its importance, a certain amount of our regard. Already, when we draw near it, we feel ourselves in an atmosphere in which lives the memory of William the Conqueror, though his ashes have long been scattered to the winds by the religious madness of the Huguenots, and, later, by the delirious intoxication of the French Revolutionists; there is something in the surroundings to tell us that we are in the place of rest of a man who left his stamp, not alone on his own, but on all succeeding ages. We feel his presence more at Caen than at Rouen, because the latter, though it was the capital of his dukedom, has so much else of interest to attract our attention, and because in the former every monument is indirectly connected with his name. We feel it perhaps more in Bayeux than in Caen, because Bayeux lays before us the real old historic records which make the recollection of the Norman Conquest like the recalling of a yesterday's dream, and we feel it still more at Falaise than at Bayeux, because we are there in the presence of buildings and monuments that, in their awful grandeur and severeness, recall the character of the man, and of the times in which he lived. Thus from Rouen, from the grace of its delightful churches, through our four Normandy towns, do we gradually descend to the gaunt severity of the Castle of Falaise; and are brought nearer to that characteristic of the Norman times which is so prominently expressed in the actions of their heroes and the character of their architecture,—plainness and severity; and certainly these two qualifications are not wanting at Caen. On regarding the Church of St. Étienne the first impulse is to exclaim:—"How very ugly!" As if William the Conqueror, when he built the church to appease the Pope, who was incensed at his marrying his cousin Matilda, had said:—"Very well, you shall have a church, but it shall be as ugly as human ingenuity can make it!" The inside conveys a different impression, the massive nave tells another story. It says in its awful sternness:—"My invincible arches will crumble in the dust first, before William the Conqueror bends to the Pope!" Hildebrand, as history tells, certainly took the hint, but whether from the columns of the Church of St. Étienne is another question. At the other end of the town is the Abbaye aux Dames, corresponding in the object of its erection to the Abbaye aux Hommes, but wearing a more feminine character, and lighter and more ornamental in its style. Built by the Queen Matilda, it recalls the more chivalrous and poetic, as St. Étienne recalls the sterner and manlier feelings of the age.

What a difference, indeed, between the dignity of the old Norman, and the triviality of the modern French character,—between what we might suppose to be the huge brawny Norman knight and cross-bowman who guarded the castle of Caen, and the modern, stunted French soldier who amuses himself by lounging and spitting on the ramparts! There is not much to see at the castle; a good view of the town, and,—a very common thing in modern France,—a graceful chapel converted into a storehouse for guns and ammunition. Let us leave Caen and go to the town that leads us still farther into the being of the past! Let us enter the peaceful streets of the old cathedral town of Bayeux.

Bayeux is one of those towns which in every possible respect merit the pathetic title of "dead-and-alive." Its streets are silent as those of an English country town on a Sunday. Its inhabitants lead lives of blissful monotony. Its whole being seems immersed in the past. But there are two things in Bayeux which give it the deepest interest, and bring us nearer to the recollection of the age of which they are such perfect representations,—the Cathedral, and the Tapestry. Reared far above the houses, the former stands as if deserted by the rest of the buildings of its own time, alone telling of the days when William called it into being, and the great Archbishop Lanfranc consecrated it. Though the main part of what we see at the present day is the creation of a slightly later age, the whole collectively, and particularly the west front in the Pointed Gothic style, and surmounted by two fine steeples, reminds us not only of the youth of Norman civilisation, which had laid the foundations of it, but also of the maturity in the succeeding century which completed it. It is one of those churches which bears on it the early as well as the finishing touches of Norman development. The other characteristic of Bayeux is that great contemporary work, the Tapestry. Many have been the writers who have given their ideas and arguments for or against the authenticity of this venerable relic, but whether we prefer to regard it from the poetic and traditional point of view, and conjure up in imagination the Queen Matilda and her maidens in their summer palace at Bayeux, stooping over their work, and diligently plying the needle and the coloured wools, while they talk of the glory of the heroes whose deeds they are recording; or whether we regard it from the less romantic, and more practically historic point of view, and believe that Bishop Odo "had it made" in England as a gift for his new church at Bayeux,—certain it is, that no words nor paintings, no histories nor romances could more clearly describe the terrible battle which it so vividly recalls.

"The town of Falaise," says Freeman, "is one of the most famous spots in the earlier and in the later history of Normandy, and none assuredly surpasses it in the striking character of its natural position." As we approach the town there rise before us two precipitous rocks, one of them crowned by the massive castle which has played such a part in the history of the Middle Ages. Leaving these on our left, we pass through a magnificent avenue of trees, from which, in old-fashioned style, are still suspended the picturesque oil-lamps, and enter the town that, more than any other, is characteristic of the Norman age. After traversing a few streets with nothing of any great interest to recommend them, we reach the Church of St. Gervais, the patron-saint of Falaise, and a little further on, the Church of St. Trinité, which, though architecturally it may be heresy to say so, makes a most charming picture when seen from one of the smaller by-streets, a portion of the west end being built over an archway, under which runs the thoroughfare, and the old building with its half-decayed masonry looms out of the background of the picture and is framed in by two rows of quaint white houses. Turning again to the left, a slight *détour* brings us to the square near the foot of the castle entrance, where stands the famous bronze statue of the Conqueror, by Louis Rochet. The impression it conveys is a striking one. Mounted on a charger, the hero of Senlac is leading on his men for the final charge, and we see him as if in the act to burst through the last rank of Harold's stubborn house-carls. The feeling of the whole work is summed up in the word "power." Around the pedestal stand his ancestors, from Rollo to Robert the Devil, small statues, also in bronze; but while they are modelled from the fancy of those qualifications which each in legend possesses, the statue of the Conqueror is wrought from the true feeling which a study of his character in both history and legend has inspired. A minute's walk brings us to the incline which leads from the town up to the castle, and it is as we mount this that we think of the real grandeur of Falaise, of the meaning of its name,—the rock; of the characteristic of its heroes,—solidity; of the terrible fastness of its castle walls, that have passed through nine tremendous sieges; of the awful tales told, and yet untold, by its dungeons and *oubliettes*; of the warriors connected with its name, and of all the romance and pomp of chivalric times. Standing upon the summit of the castle, we see stretched beneath us the peaceful fields in which the quiet Norman peasant now feeds his flocks, where runs the little river Aute, on the borders of which, among the grass and flowers, the beautiful Herleva, the mother of the Conqueror, the tanner's daughter, as the legend tells, was espied by the young Count Robert, who loved her, and bore her off to his castle.

Falaise! the very ring of its name is like the blast of a trumpet, at which the old clank and dignity of Feudalism once more revives. We

see knights and barons encased in armour, receiving chivalrous love-tokens from the hands of their ladies; we see sturdy cross-bowmen and pikemen; we hear the clanking and rustling of maces and halberts, the ring of steel corselets, and the champing of steeds; we catch the stray notes of wild music from the lips of some troubadour, who is singing the fiery stanzas of the Roman de Rou; we see the bustle, the glitter, and the pomp; and, lastly, a huge figure emerges from the crowd. There is a hush; all bow in reverence. We recognise who it is at once, for he bears on him the armour of the statue of Rochet, the armour that the Bayeux tapestry recalls, and he has impressed upon his face that terrible dignity and relentless determination which mark him as the hero of his age,—the Conqueror of England.

ELECTRIC LIGHTING.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

THE eighth ordinary meeting of this Institute for the present session took place on Monday last, Mr. David Brandon, vice-president, in the chair.

The hon. secretary (Mr. J. Macvicar Anderson) intimated that the second moiety of 25*l.* in connexion with the Soane Medallion had been awarded to Mr. Robert Alexander Briggs, Associate. Mr. Briggs's sketches combined great accuracy with considerable artistic power. The Council considered they were not only justified in making this award, but had great pleasure in doing so.

Mr. Killingworth Hedges, A.-M.Inst.C.E., then read a paper entitled "Precautions to be adopted in introducing the Electric Light into Houses," of which the following is a summary:—

The author began with a reference to two papers on the electric light read before the Institute by Mr. Slater in 1881 and 1882 respectively, and spoke of the great progress made since in the commercial application of the invention. To facilitate the lighting of streets and private houses, the Electric Lighting Act of 1882 was passed, under which twenty-three applications for provisional orders were made in that year by local authorities, and 106 by companies formed for the extension of the system, which, however, the stringency of the regulations laid down by the Board of Trade had temporarily checked. Meanwhile, a largely-growing number of occupants of houses had set up the necessary plant for producing the light themselves. A description was then given of the plan for supplying electricity to private dwellings by means of batteries. The most effective system of the kind seemed to be that invented by Mr. Ross. The various modes of generating electricity were next rapidly reviewed. In town houses a gas motor was, as a rule, the best; in country houses all three sources of power,—water, steam, gas,—had been employed. Common coal gas could be dispensed with by using Dowson's gas, of which a description was given, and whose great advantages were set forth at length. The cost had proved to be 50 per cent. less than that of the ordinary article at 3s. per 1,000 ft. The engine-house would contain the dynamos, which should be fixed on wood, to insulate them electrically from the ground. From the dynamos the current should be taken to a switch-board. If accumulators were used the current from these would join on to the same board. From this switch-board the mains went to the lamps, starting as a large cable, which branched away like the gas-pipes, until each incandescent lamp was reached. It was of the last importance in electric lighting that the current should always be uniform at all times in each individual part of the work, and independent of changes in other parts. The compound-shunt machine for effecting this was then described, and it was shown that by means of it the regulation of the electric supply is more perfect than that of gas. The honours of this invention were claimed by several of our British electricians. A highly effective form of the machine was that designed by Messrs. Crompton & Kapp, who had greatly improved on the Bürgin dynamos, while Dr. Hopkinson had not only materially reduced the cost of Edison's, but had increased the commercial efficiency some three per cent. The actual efficiency of the improved Edison-Hopkinson dynamos was now 94 per cent., and its commercial efficiency 88 per cent. To enter, however, into a comparative description of the different systems possessing these advantages, and to discuss their relative merits, was beyond the author's scope, and he therefore proposed to describe some of the principal features of a supply of electricity, and to point out the precautions necessary to its safe introduction and the guarding against fire risks. In the first place, to understand what this electricity is, the author said, we must disabuse our minds of the notion of that "invisible subtle fluid" of which men still talked so nervously, but which we daily used with impunity for ringing bells and working telephones. The electricity used for lighting was doubtless far more dangerous if uncontrolled, but if properly installed it was made as harmless as the galvanic battery employed by the popular lecturer in his experiments. The light was nothing but electric energy in the form of white heat, and the only peril was that this heat might be developed where it was not wanted, and might so cause fire. The possible danger from this cause had already attracted much attention both in this country and abroad. A Special Fire Risk Committee appointed by the Society of Telegraph Engineers and Electricians was formed in 1882, and a set of excellent rules were drawn up by it, which were adopted *mutatis mutandis* by some of the insurance companies, and also by the Board of Trade in its "model order." Neither these rules, however, nor the "Standard of Requirements" laid down by the New York Board of Underwriters, could be said to embrace all the changing details of an electric light installation. Such details could only be arrived at after the electricity had been worked a sufficient length of time, and had been generally distributed like gas. With a view of eliciting further discussion on the subject, the author proposed to offer a few general remarks as a small addition to what had already been put forth by the Fire Risk Committee. The first source of danger to property, he said, is in the mains and branch wires [which conduct the electricity from the engine-house to the incandescent lamps, which were distributed over a house in much the same way as gas. If these conducting wires were of sufficient calibre, and made of a material uniform in its resistance, the current would not develope in its passage any dangerous heat. In arguing the question as to the proper sectional area of the conductor, the author remarked that the electro-motive force had been compared to the difference of head of water necessary to cause a quantity of fluid to overcome the resistance of a pipe, whereas it was more like water soaking through sand, in that the whole of the cross-section of the wire interposes a resistance which in large conductors doubtless varies proportionally to the temperature of each section according to its distance from the outside radiating surface. As for the material of the wires, it was commercial copper, which was never absolutely pure, but could be got as high as 96 to 98. Now, since the wire's resistance depended on its purity, a short length of inferior wire might upset calculations based on the hypothesis that none but the purest wire is used. Thus not only might that inferior section become dangerously heated, but there would also be a waste of power. Copper was always used for electric-lighting purposes, both because it can be got purer than any other available metal, and because next to silver it is the best conductor of electricity. Having examined the proportion of the electric conductors to their work, the author went on to discuss the question as to the effect of a stream of electricity continually passing along them. He had found that if heating goes on largely, a change in the conductivity of impure metals may take place, but pure copper is apparently unchanged. A summary view of the evidence on which this conclusion rests was given. Passing thence to the subject of electrical connectors and joints, the author said special attention should be given to these, including not only all the joints where the branch wires lead off, but also the connexions made with binding screws. Besides causing resistance in the circuit, bad contact between a wire and a terminal would engender heat; hence the area of the contact piece should be large enough. It was further shown how provision should be made in the case of a sliding connexion for taking up the wear and firmly pressing the surfaces together. The joints used were most important factors in an electric light installation. For these joints solder alone should never be relied on. A joint must be made mechanically perfect, and considerable pressure used to unite the surfaces; the solder might be then applied to keep the whole air-tight. The next section of the paper showed how the danger arising from short circuits was to be met. The term, it was remarked, meant that the current instead of going a circuitous route takes the shortest path, where, having no work to do, it causes fire. The three ways in which short cuts might be set up were pointed out, as well as the measures to be adopted in such emergencies. The only preventive was a cut-out or safety fuse. The author referred to experiments of his own in order to ascertain the most suitable and reliable material. After trying numerous foils he obtained a special alloy of aluminium, whose resistance, as compared with that of silver, was about 45 per cent. Testing an installation was the next subject for consideration. To ensure this being properly carried out, a current, capable of overcoming a high resistance, should be sent through the whole of the wires; that from an ordinary battery was of little use. A portable hand-apparatus was used for this purpose in America, which, on turning a handle, sends a current through every one of the wires, and shows any leakage by ringing a bell. The foregoing remarks, said the author, had been made with reference to incandescent lighting, but applied to arc lights also, which latter brought with them other fire risks of their own. The chief of these was the danger arising from pieces of incandescent carbon dropping, and more fires had occurred from this cause than from any other. Before quitting this subject he gave some interesting information as to how some of the fires caused by the electric light in America had happened. In one district, in which there were sixty-one mills, fifteen fires were due to some form of "short circuit," generally owing to the leakage of water or the washing of floors. All of them would have been prevented by proper insulation and reliable fusible safety plugs. Three fires were caused by cross arcs of one wire to another, where uninsulated wires were fastened against conductors. In one instance the conductor was formed by dust settling upon uninsulated wires, and on a damp day it absorbed enough moisture to make a path for the formation of a cross arc, which started a fire. In a second case the wires were fastened to a damp beam which was decayed and burned nearly in two by a smouldering fire. In a third instance damp brickwork in a tunnel became a sufficient conductor to set up an arc which did no material damage, but injured the dynamo. These fires were not necessarily destructive, as they generally occurred during working-hours, and so were soon discovered and dealt with. Electricity, though having no smell, like gas, to betray a leak, showed when it was escaping by the diminished brilliancy of the lights. In London Captain Shaw reported no fire as due to the electric light for 1882, and but one in 1883; this was due to the overheating of the wires. In this country the installations had, as a rule, been in the hands of skilled persons. It was most necessary that in the eagerness and hurry to push forward the new light, the work of wiring houses and fixing the lamps should not be left to bell-hangers and others destitute of the requisite knowledge of electricity. The best guarantee of safety in the use of electric light was the employment of experienced men in the work of installation. In such hands it was far less dangerous than gas, which not only poisons the air we breathe, but ever lurks as a slumbering volcano ready at any moment to put forth a terrific power. When properly installed and managed electricity was by far the safest illuminant known. It was to be hoped the insurance offices would soon recognise the fact by reducing the premium on all buildings from which gas is excluded. The alleged comparative immunity of the electric light from accident was accordingly treated more in detail in a special section, which was followed by the author's closing remarks on the important subjects of wear and tear and working cost, all of them involving a good many technicalities in their discussion.

Mr. Slater, in opening the discussion, referred to the disappointment which had been felt at the comparative want of success of the electric light. Three years ago, when he brought this subject before the Institute, people believed that there was a brilliant future before it, and the public mind was excited by an unwarranted belief in the immediate commercial success of the supply of the electric light on a large scale. This had brought about Stock Exchange specu-

lation and immature installations, followed by the most unfavourable results. If ever there was an invention for which the motto *festina lente* should have been adopted, it was that of the electric light. And in spite of all the attacks which had been made upon it, he would ask if it had in reality been a failure? He had only to point to the numerous hotels, steamships, and private residences in which the light was used to show that it had not been a failure. Many difficulties had to be surmounted before houses could be lighted with the regularity and simplicity attending the use of gas, but these were gradually being met. Mr. Hedges had rather thrown two difficulties in the way of domestic electric lighting, in regard to the wiring of the houses, and the fittings for the lamps. In the case of a new house, arrangements could be made for chases where the wires were to go, and they could be covered by raised mouldings, there being no better non-conductor than plaster or cement. If they cut the joists, and the walls or ceilings, injury might be done to the interior decorations, which would lead to no end of expense. The best plan was not to attempt to conceal the wires, but to cover them with insulating material, corresponding in outward colour to the existing decorations. Two years ago he expressed himself in favour of doing away with fittings to a large extent, and the result of experience had confirmed him in that view. Single lamps depending from the ceiling, and sustained by very fine cords, had a good effect. Artistic and tasteful fittings were brightest, but expensive, and if not expensive they were nasty. On one point caution was necessary. It was not wise, for economy's sake, to utilise existing gas-fittings. They looked incongruous, and the electric wires passing through gas-pipes seemed to rapidly deteriorate, which might lead to disastrous accidents. He concluded by proposing a vote of thanks to Mr. Hedges.

Mr. Blakesley bore testimony to the excellence of Mr. Hedges's foils. Without such things electrical plant would be extremely dangerous, but with those foils the light became perfectly safe.

Mr. E. A. Grüning said that he had two installations in hand at present, but he was not yet able to say what the cost would be. He seconded the vote of thanks.

Mr. Hebb remarked that the advantage of the light in public buildings, and especially in theatres, must be indisputable. He would like to know if there were any special precautions against accidents in the case of installations in theatres. He believed the light would be more extensively used in theatres, and the Metropolitan Board of Works were considering the advisability of revising the regulations for theatres made some time ago.

Mr. Crompton referred to the great development of the light. The dynamos had been so improved that they now gave two and a half times what they did two years ago. The lamps lasted twice as long, and the cost of the apparatus had been proportionately decreased, while the liability of the light to go out had been removed. In fitting up the light in old houses, he had utilised the services of ordinary bell-hangers, which had greatly reduced the cost of wiring the houses. The plan adopted was to light the rooms from the ceiling, taking up the floor above, threading the wires through the joists, and piercing the ceiling. Danger was minimised by the use of good materials, but if the estimates were cut down the lighting might become dangerous. Out of some 70,000 or 80,000 lights he had never had an over-heated wire. The greatest dangers were to be feared from bad and cheap workmanship. The electric light was not dangerous, for with a small modicum of care, and a proper sum allowed for wiring, the danger was infinitesimal compared with that of gas.

Mr. Hedges, in replying, said he had not given details as to the wiring of houses, as electricians seemed to take different views on the subject. It was impossible to run wires all over a house when a man had spent a great deal on its decoration. The use of the electric light in public buildings was a great subject. It would never do to put all the lights on one wire, in a place where many people were crowded together. There was no difficulty in leading the large main into a theatre or public building, but it was very necessary to have a very thick insulation. He agreed with Mr. Crompton as to the danger of gas as compared with the electric light. Indeed, Captain Shaw had informed him that if the light were generally used, half of the present fires would never occur.

The vote of thanks was then passed to Mr. Hedges, and the proceedings terminated.

MONUMENTS OF LYCIAN ART.

THE TOMB AT DJÖLBASHI.

PROFESSOR NEWTON'S sixth lecture of this course,* delivered at University College on the 8th inst., was principally devoted to the subject of the Lycian language and the written character, as they are known to us through inscriptions found in Lycia, and especially those on the great obelisk or stelè of Xanthos, which is a square pillar, about 20 ft. high, and is covered on the four sides with a long inscription in the Lycian language. On one side twelve lines of a Greek metrical inscription are inserted in the middle of the Lycian text. This metrical inscription, of which the first line is borrowed from a celebrated epigram by the lyric poet Simonides, celebrates the deeds in war of a certain Harpagos, probably a descendant of the Persian general of that name, who conquered Lycia for Cyrus after the overthrow of Crœsus. The Lycian text of the great Xanthian stelè has not yet been satisfactorily interpreted, but Savelsberg has recognised in it the names of the second Artaxerxes and of his successor Darius, of certain satraps otherwise known to us from coins or ancient authors, and of the Athenians, Spartans, and Ionians, who are grouped together in the same part of the text. Hence he conjectures that the inscription relates to the league of certain satraps with the Athenians, Spartans, and Ionians, which was formed about B.C. 366, and which was defeated by a satrap who remained faithful to the King of Persia. The date of one of the bilingual inscriptions is fixed by the mention in it of Pixodaros, who reigned in Caria, B.C. 340-30, and who appears to have conferred some benefit on the cities of Xanthos and Tlos.

In his concluding lecture, Professor Newton gave an interesting description of the tomb at Djölbashi, discovered in 1842 by a German traveller, who purposely concealed its exact situation, in order that his intentions might not be anticipated. From 1842 the tomb remained unvisited until the recent expedition of the Austrian Government, conducted by Professor Benndorf, who is at present Keeper of the Antiquities in the Museum at Vienna. It appears that some two years ago a society, which was formed in Vienna somewhat on the model of our Dilettante Society, provided the funds for sending Professor Benndorf out as the head of an expedition to make surveys and photographs of this part of Lycia. The only report of this expedition which had yet been published (as far as the lecturer knew) was printed in the "Proceedings" of the Academy of Vienna. The remarkable sculptures of the tomb at Djölbashi had now been sent to the Museum at Vienna, and he was glad to say that casts of some of them would be exhibited in the Gallery of Casts which was to be opened at the South Kensington Museum in May next. The work of transporting the sculptures to the coast was one of extreme difficulty, and the members of the expedition encountered considerable privations, as the tomb was built upon a plateau 2,800 ft. above the level of the sea, in the midst of a desolate and rugged country remote from inhabited parts. It was to be wished that the enterprise shown in this work by the Government of a comparatively poor country like Austria would have the effect of reviving in this country something at least of that spirit of splendid enterprise with regard to Classic antiquities which was formerly displayed by us, but which appeared to have quite died out of late years. The site of the tomb at Djölbashi was an acropolis, with a great wall of Cyclopean masonry round it. Surrounding this acropolis were a great number of the tombs with pointed roofs described in a former lecture.† Abutting against the wall of the acropolis was the great tomb, which on plan was a parallelogram from 60 ft. to 70 ft. in length, the external face of the walls on each side being built with hewn stones of large size. On each side of the door or entrance to the tomb (which was on the south side) was a double frieze in relief, which ran along the whole south face of the building. This was not continued along the outer face of the other walls, but upon the four inner walls, at a corresponding height, was a similar double frieze. Immediately above the exterior of the doorway were four great projecting bulls' heads, and immediately in the centre was a Gorgon's head, placed there, no doubt, to avert the Evil Eye. Below these were small figures of two men and two women, with two attendants and two dogs. These groups, no doubt, represented the persons or families to whose honour the tomb was erected, they being placed quite apart from the sculptural decorations contained in the friezes. On the western side of the doorway the sculptures represented a battle of Amazons, and below this a battle of Centaurs. On the eastern side of the doorway the upper sculptured frieze represented the famous fight of the Seven Argive chiefs against Thebes, while in the lower frieze was a representation of an Oriental potentate receiving homage. Passing inside the doorway the sculptures of the doorway itself were very curious. Over the door was an extraordinary group of little dwarfs, apparently something in the nature of Satyrs, playing upon musical instruments. On each side of the doorway were two male figures, standing. They were corresponding figures to those which occur in the tomb in the Lycian Room at the British Museum. Proceeding to describe the double frieze running round the interior walls, the lecturer traced the various subjects represented, which were illustrated by means of photographs and drawings. One of these subjects was the slaying of the Calydonian boar, which must have been originally a very fine composition, although now (like the remainder of the sculptures) considerably decayed. Another interesting subject was the slaying of the suitors of Penelope by Ulysses, as recounted in the Odyssey. On the interior of the west wall was a most remarkable continuous composition representing the siege of a city on a coast, there being at the beginning of the composition the prows of vessels hauled up on the beach just as they were in the Trojan war. A peculiarity in these friezes previously unknown to us is that the friezes are not distinct,—*i.e.*, the subjects of the upper and lower friezes blend with or merge into each other in a manner which is quite new to us. The other subjects represented in these internal friezes were the Battle of the Greeks and Amazons, and (on the north wall) a remarkable composition representing the carrying off of the daughters of Leukippos by Castor and Pollux. On the eastern wall were represented the exploits of Theseus. Within the space enclosed by these sculptured walls was a magnificent sarcophagus, which remains *in situ* at present, though the Austrians hope to remove it next year. Its removal will be attended with considerable difficulty, as it is of immense size, and weighs many tons. One remarkable feature about these sculptured friezes was the amount of perspective exhibited in them, which was very noteworthy, and, in the opinion of many, afforded proof that these sculptured representations were copied in stone from painted representations of the same compositions, by Polygnotus or some other Athenian painter. We knew that some of the subjects sculpturally depicted in this tomb were painted by Polygnotus. As to the date of these sculptures, the lecturer was inclined to think that they were produced about the year 350 or 360 B.C.,—a somewhat later date than that assigned to them by Mr. Murray, who thought they dated from the fifth century B.C. He wished he could say to what Lycian potentate this sumptuous tomb was erected. He did not know whether any inscriptions had been found which would be likely to throw any light on this point. In conclusion, the lecturer again adverted to the example which Austria had shown us in undertaking this expedition. Every thing in this direction which had been undertaken by this country of late years had been done in *a half-hearted and inadequate manner*. As a case in point he referred to Mr. Wood, who had been endeavouring to complete his investigations on the site of the Temple of Diana at Ephesus, and who, failing Government aid, had been sent out with the miserable sum of 400*l*. or 500*l*. (liberally raised by subscription among a few friends of the work) when he ought to have been provided with as many thousands of pounds to enable him to do his work properly.

* See *Builder*, pp. 92, 142, 161, 194, *ante*.
† See p. 161, *ante*.

EGYPTIAN ARCHITECTURE.

[WITH ILLUSTRATIONS.]

ON the 14th inst. Mr. R. S. Poole, LL.D., gave his second lecture on Egyptian architecture at the Royal Academy.* After a few words about the books which students ought to read, in order to gain a thorough knowledge of the subject, and the recommendation of Perrot and Chipiez's "History of Egyptian Art," translated by Mr. Walter Armstrong, the essential handbook of the subject, giving all needful reference to the several authorities; Wilkinson's "Architecture of Ancient Egypt," useless in theory, but with admirable plates, firmly drawn and hand-coloured; also the larger works of Lepsius, Rosellini, and others, he spoke of the third period of Egyptian architecture, namely, that of the empire from 1600 to 1200 B.C. In the last lecture he had spoken of the religious character of the tomb, and had mentioned that towards the close of the pyramid age it became more historical. From 2500 B.C. to 1600 B.C., during the second period, of which the monuments are scanty, it developed architecturally, use being made of the many-sided fluted column, the so-called Proto-Doric, which originated from the old square column, as seen in the Temple of the Sphinx, pl. 3 (A). It had in the case of the excavated tombs at Benee Hassan three parts, the portico, the hall of columns, and a very small chamber or niche, in which was the statue of the deceased, this niche being the survival of the corridor. The statue was an architectural feature, and no longer the living representation in which the shade could dwell. In the age of the Empire the tomb grew into a temple. It is worth noticing that at this time it had before it a little garden, a miniature of the planted enclosure which surrounded the temple. The deceased prays in the sepulchral tablet that his soul may here enjoy the cool north breeze, and the fragrance of the flowers. (See E), where we see the widow visiting the garden to bewail her husband, a most interesting tomb of an earlier date, discovered last year by Professor Maspero, high in the side of the desert rock in Western Thebes, had its entrance concealed by a very ancient laurel, the last survivor of the little garden, which once made its front gay with flowers. The royal tombs must also be noticed as deep excavations in the mountain, combining the principle of the interior of the pyramid with that of the ordinary tomb (B).

There were now two kinds of temples,—the temple proper, which was used for worship, and the sepulchral temple of Thebes, which was the chapel of the king's tomb, hidden in the valley behind. Each temple had three essential parts, —the portico, the hall of columns, and the sanctuary; and this is sufficient to prove the derivation from the tomb; in fact, the plans of rock-temples and rock-tombs were identical (comp. D, F, with C). The temples, sepulchral or not, were dedicated to the gods; but the records which they contained were chiefly historical. Thus the great temple of Thebes at Karnak, the "Westminster Abbey of Thebes," recorded a multitude of historical events, and the earliest treaty extant, one made between Ramses II. and the Hittites, 1400 B.C., was placed on one of its walls. The materials used were sandstone and red granite. In Upper Egypt the walls were of sandstone and the doorways of granite. In Lower Egypt the buildings were made entirely of granite, the columns being solid monoliths. The great temple of Tanis, 600 ft. long, was wholly composed of this costly material, brought nearly 900 miles by river. The form of the temple was purely rectangular. The main structure was always perpendicular, sometimes with a winged portal having sloping sides to vary the effect of the horizontal lines. Farther, the horizontal lines were cut by the obelisks and by the tall flagstaves which were attached to the front of the winged portals. The Egyptians had, in spite of, or because of, their quadrangular plans, a dread of the effect of absolute symmetry, which has been called symmetrophobia. Thus, in the period under consideration, they placed a wholly different order of columns at the opposite sides of a court. This principle was more subtilely carried out under the Egyptian Renaissance by the combination of different columns, balanced by their repetition at regular intervals, thus: 1, 2, 3, 3, 2, 1,—in the front of a portico. Some temples, moreover, had a double axis, like the churches of which the nave and chancel-chapel are necessarily placed in somewhat different directions (I). A temple at Abydos has a strange form, which makes it like an inverted ⅂ (G. Cf. also F, for several deviations). The chambers and courts were usually made each narrower than the one that went before (F, H, I), an artifice which lengthened the view to the people, who were only allowed to enter the great court while the priests passed into the hall of columns, and the king, or his representative, entered the sanctuary at the very end. Thus the worshippers in general never looked back.

The entrance court, the hall of columns, and the sanctuary, with their adjuncts, were all sculptured or painted, even when the material was granite,—granite being used for hardness, not colour. The wall of circuit was made of crude brick, with granite portals. From its principal portal the way led between an avenue of sphinxes, rams, or lions, and was closed by a pair of obelisks. The lions were fine works of sculpture. Mr. Briton Riviere, R.A., in a letter to Mr. Poole, which he has kindly authorised him to print, speaks of the excellence of the type of the Gebel Barkal lions in the British Museum as having profoundly impressed him "by its excellence as a translation of a lion into an architectural form. This the unknown Egyptian artist has done to perfection. Not only has he rendered into stone in a masterly manner the large lines of the animal, and thus shown that he had no mean knowledge of its anatomical structure, but (and this is, indeed, rare in decorative art of so broad a character) he has saturated his work with those distinctive and more subtle characteristics of the lion upon which, I believe, the majesty of his appearance depends; and to do this as he has done it he must have been not only a keen but an imaginative observer of nature. Any comparison between this and the Assyrian lions seems to be profitless. They, on their own ground, will always be matchless; but this lion does not lie upon their ground."

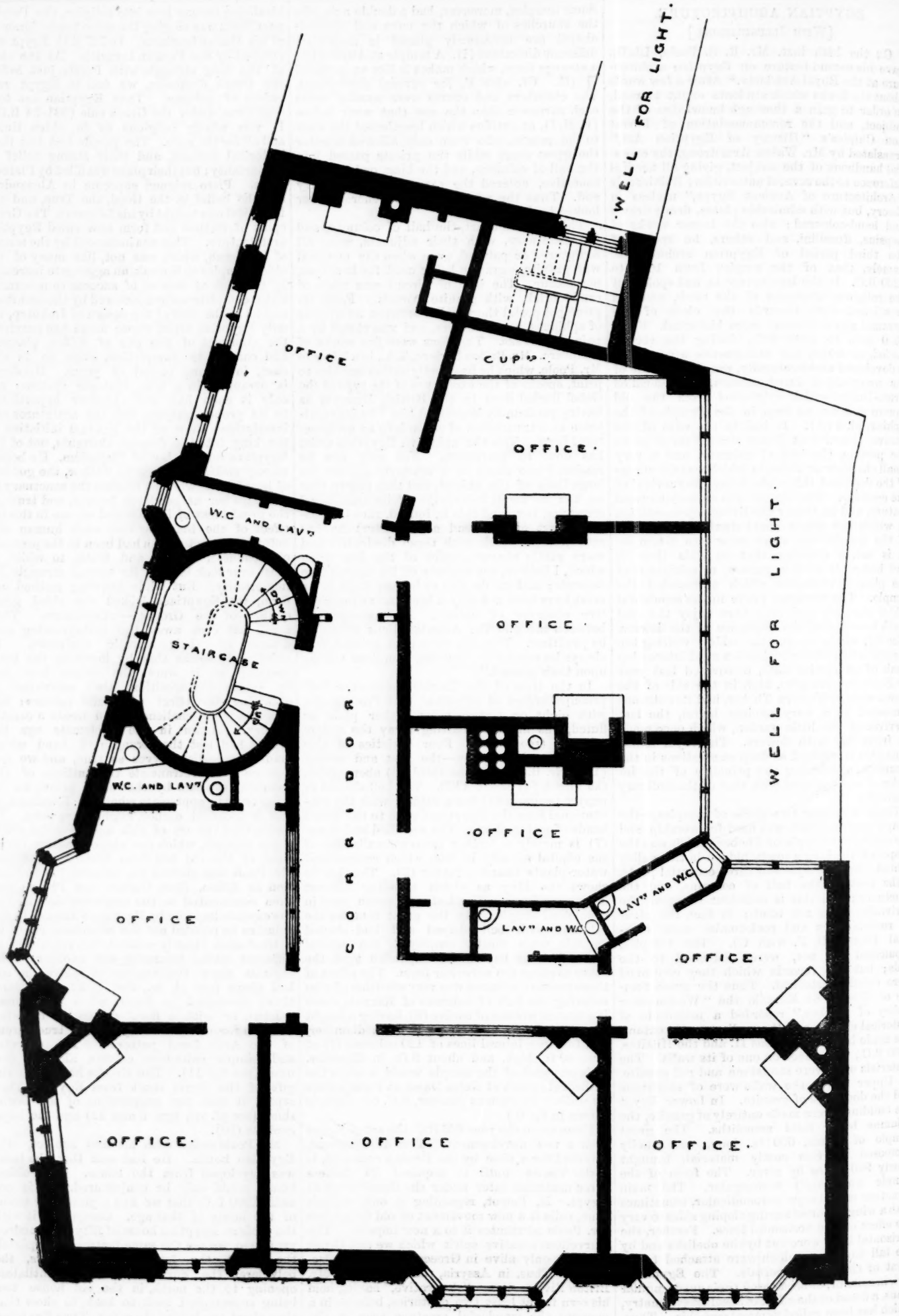
In the time of the Empire there were four principal orders of columns. The Proto-Doric, with eight or sixteen sides, either plain or fluted, was made by cutting away the square columns (see pl. 4). Four varieties of this column are here given—the first and second (1, 2) *cir.* B.C. 2500, the third (3) about 1600, the fourth (4) about 1400. The bell-shaped or papyrus column (8) has a capital with the conventional form the Egyptians gave to the tufted heads of water-plants. The so-called bud-shape (7) is merely a farther conventionalisation of the capital already in use, which represented water-plants bound together (5). The Osiride shows the king as Osiris standing against a square column. The last was much used in sepulchral temples. In the great temples the columns with bell-shaped and bud-shaped capitals were mostly employed, the central higher avenue having the expanded type, the other avenues the narrower form. The effect of these massive columns was very startling; for on entering the hall of columns of Karnak, there is a central avenue of twelve (8), having a height of nearly 70 ft., and about 12 ft. in diameter, and fourteen lateral lines of 120 columns (7) of over 40 ft. high, and about 9 ft. in diameter. This one part of the temple would contain the cathedral church of Notre Dame at Paris within its walls. (A curious pilaster, B.C. *cir.* 1300, is shown in fig. 6.)

From about the year 666 B.C. the art of Egypt took a new development. This development, retarded for a time by the Persian conquest, is little known until it acquired its fulness three centuries later under the Greek kings of Egypt. M. Perrot, regarding it only at this time, calls it a new movement of old forms, but Mr. Poole attributes it to a new impulse. The marvellous creative spirit which we call Greek was not only alive in Greece, but stirred elsewhere. Thus, in Assyria, the lion which Mr. Briton Rivière terms "decorative," having held his own for at least two centuries, became in a moment the wonderful creature seen in the reign of Assurbanipal, full of what the same authority terms "the essential natural"; and in Egypt the artists were animated by a novel instinct, which resulted in the creation of graceful figures and new attitudes. The new spirit was in the air, and all artists felt its invigorating influence; even as we find with art's twin sister, poetry, in the fourteenth century. For in the age when Dante and Petrarch were idealising human love into religion, the Persian poet Háfiz was singing the same music, ignorant of his Italian brethren. In 527 B.C. Egypt was crushed by the Persian invasion. At the close of the long struggle with Persia, just before the Greek dominion, we find in Egypt new orders of column. Thus Egyptian art took final form under the Greek rule (331–24 B.C.). It was wholly religious as in olden times, and all for the gods. The people had lost their historical instinct, and their strong belief in immortality; but their place was filled by Platonic ideas. Plato reigned supreme in Alexandria, and the belief in the Good, the True, and the Beautiful was taught by his followers. The Greek spirit of method and form now ruled Egyptian architecture. This was instanced by the temple of Denderah, which was not, like many of the older temples as Karnak, an aggregate increased by the wish or caprice of successive monarchs, but a complete unity conceived by the architect, and as in the case of the design of Imhotep, the only Egyptian artist whose name has survived, the architect of the pile of Edfoo planned, and carried to completion, even, as in this case, in a long period of years. Denderah is arranged in a true Platonic system: not only is each hall and chamber apportioned to its proper purpose, but the sculptures and inscriptions show us the gradual initiation of the king into the deepest thoughts, not of the Egyptian religion, but of Platonism. He begins merely making offerings to Hathor, the goddess of beauty, but when he reaches the sanctuary he worships her as goodness, beauty, and truth,—the great ideas of Plato,—and we see in this the effect of the teaching that each human soul before it came to earth had been in the presence of goodness, beauty, and truth, to which it must ever look back in its mortal struggle for immortality. But while knowing method and form, the Egyptians lacked the third great quality of the Greeks, — elimination. They could not cast away the embarrassing conditions of their hieratic sculpture. In painting it seems that by lowering the tone, choosing as it were the minor key, and by subtle juxtaposition, they succeeded in obtaining the effect of mixed colours; but this idea is yet challenged, and needs a careful inquiry. Again in the Ptolemaic age the artists had lost the strength of hand which made the earlier curves so true, and we feel that we must retranslate the outlines of the beautiful capitals by the older principles in order truly to appreciate what the Renaissance, had it bloomed earlier, might have been. To understand the art of this age we must study these capitals, which are almost endless variations of the old bell-form besides new types. Mr. Poole first showed the columns in combination at Edfoo, Esne, Ombos, and Philæ; and then commented on the charming drawings of the capitals lent him by Mr. Phené Spiers. In the columns he pointed out the admirable effect of a treatment already noticed, the repetition of different modes balancing one another. The capitals show the variety of plays on the bell shape (see pl. iv., figs. 9, 12, 10), sometimes developed in itself when it becomes a lotus, or with a floral arabesque covering its main forms, which may be the true parent of the Arab floral patterns. The graceful and simple palm-tree column also is now used (see fig. 11). The Greeks had taken the gift of the Doric shaft from Egypt. They repaid it with the suggestions of the Corinthian (see pl. iv., figs. 9 and 12) and the Ionic capitals (10).

Mr. Poole ended with his first subject,—the Egyptian house. He had said that the tomb was developed from the house. The oldest house could only be conjectured. It is not until 1500 B.C. that we find a picture or model of the house of that age. Comparing it with the modern Egyptian house of fifty or a hundred years ago, we see the same features, the portal, the court, the lattice-work windows, the belvidere, the curious standing ventilators opening to the north, in the old house two being represented back to back, to show that they stood one behind the other. Thus Egyptian art cannot be understood unless it is viewed in its whole range of 5,000 or 6,000 years.

* For a summary of the first lecture, with illustrations, see last week's *Builder*.

Borough Engineership, Dewsbury.—Mr. Horace Hey, of the city surveyor's office, Manchester, has, at a meeting of the Dewsbury Town Council, been appointed borough engineer for that town. There were 102 applicants.



FIRST FLOOR PLAN

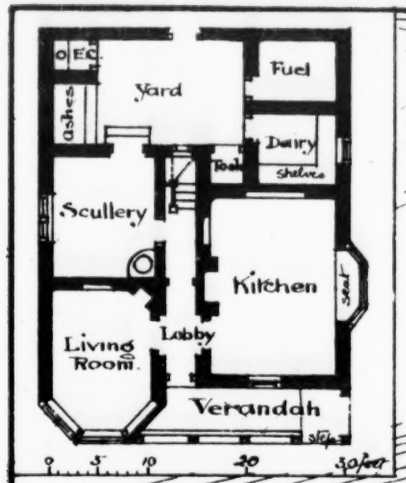
0 5 10 20 30 40 FEET

SCALE.

NEW PREMISES, CHURCH GATES, SHEFFIELD.—Messrs. M. E. Hadfield & Son, Architects.

Gardener's Cottage — at Balrath-Bury, Co. Meath for C. A. Nicholson Esq.

T. N. Deane & Son, Architects



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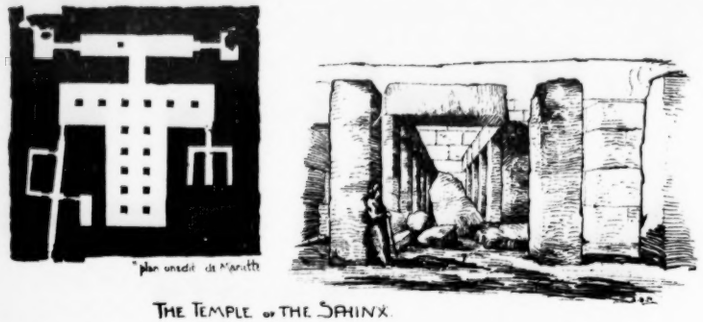
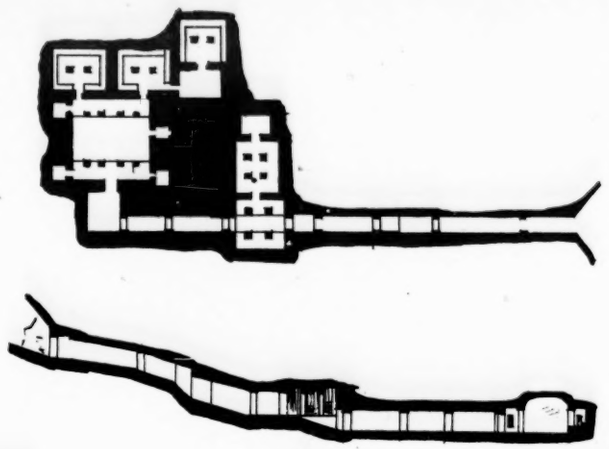


THE TEMPLE OF THE SPHINX

A



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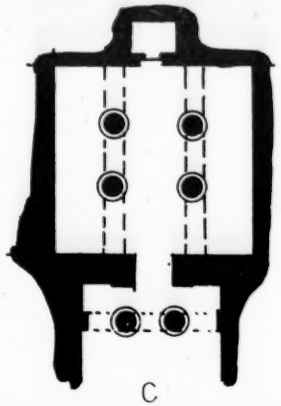
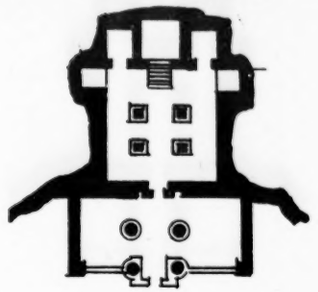


C

ROCK TOMB BENI HASSAN



D

TEMPLE OPPOSITE EDFOV

FROM WILKINSON

THE TOMB OF RAMESES II AFTER PRISSE

E

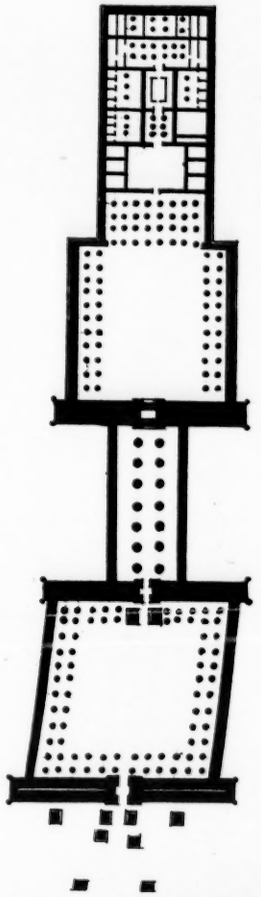
AFTER MASPERO.

THE GARDEN BEFORE THE TOMB.

F

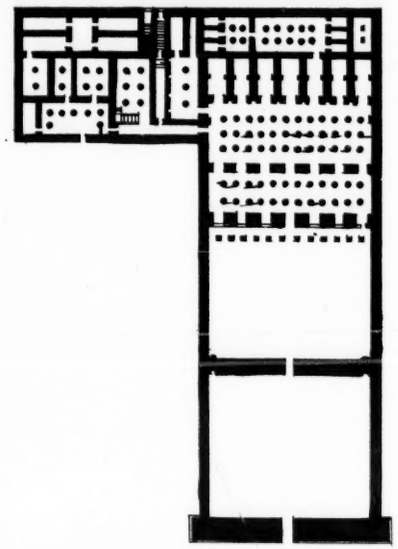
GREAT TEMPLE ABOOSIMBEL

FROM WILKINSON.



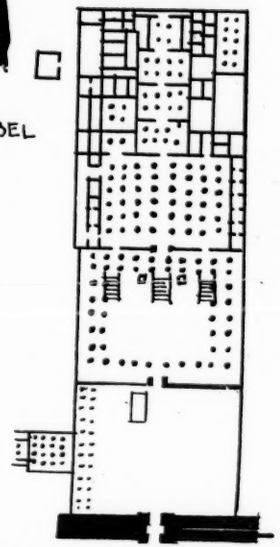
I

TEMPLE LUXOR



TEMPLE AT ABYDOS FROM MARIETTE

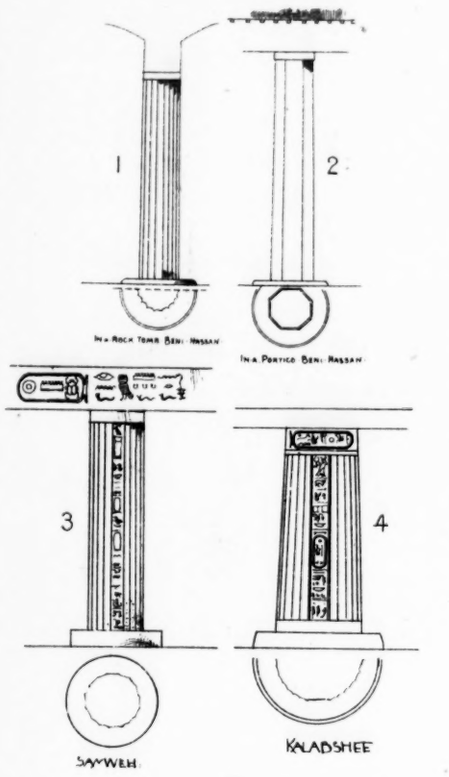
G

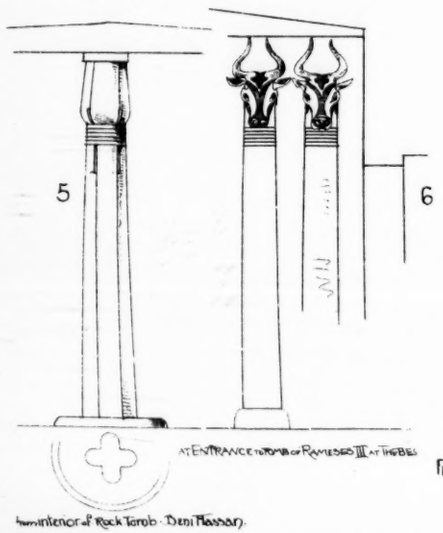


H

THE RAMESSEUM, FROM LEPSIUS.

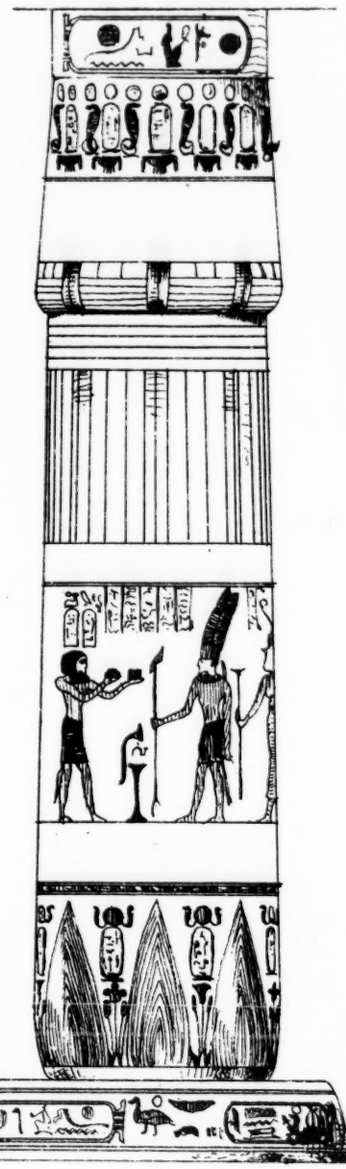
PLATE 4.





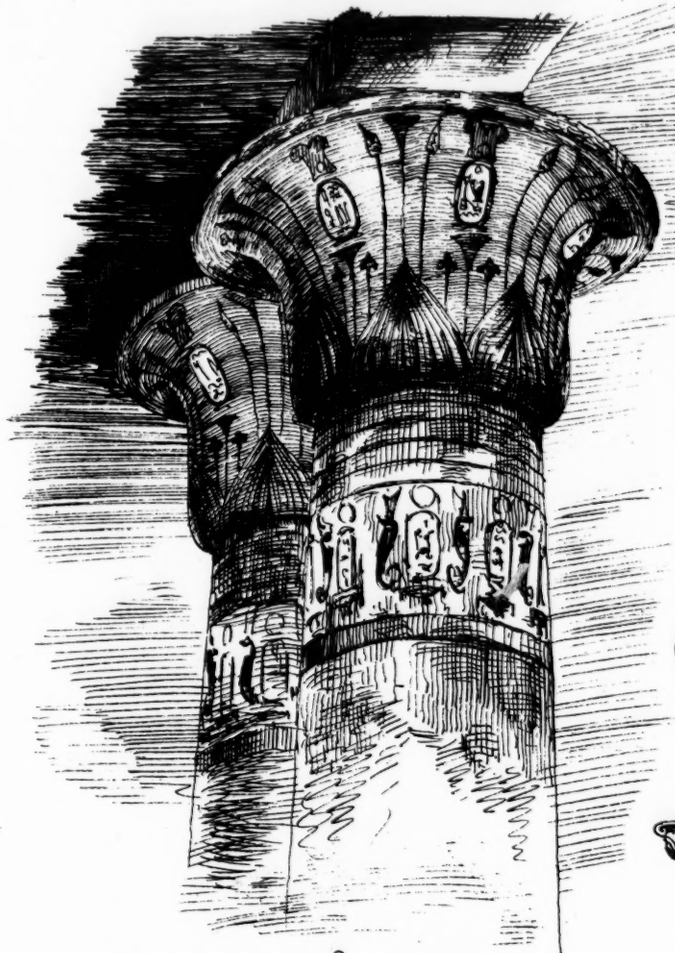
AT ENTRANCE TO TOMB OF RAMESES III AT THEBES

from interior of Rock Tomb - Beni Hassan.



7

FROM THE LATERAL COLLONADES of the RAMESSEVM



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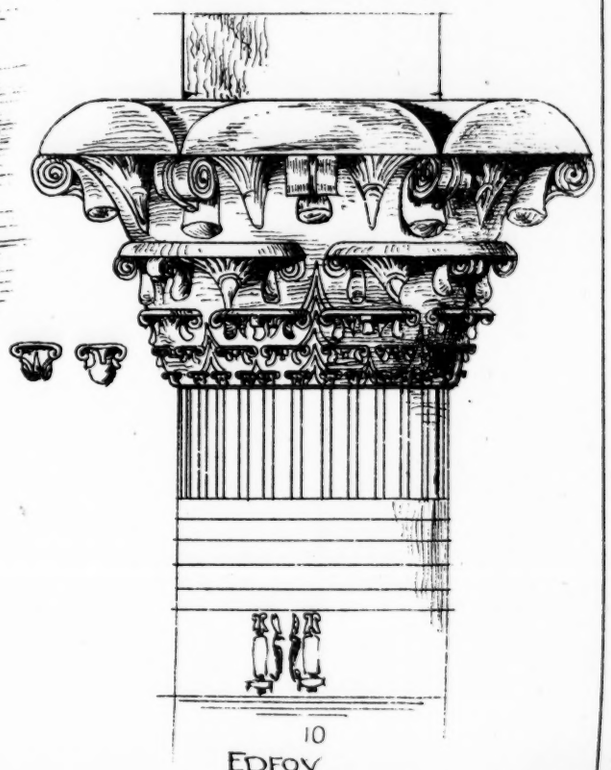
FROM THE HALL OF ASSEMBLY IN THE RHAMESSEVM

9

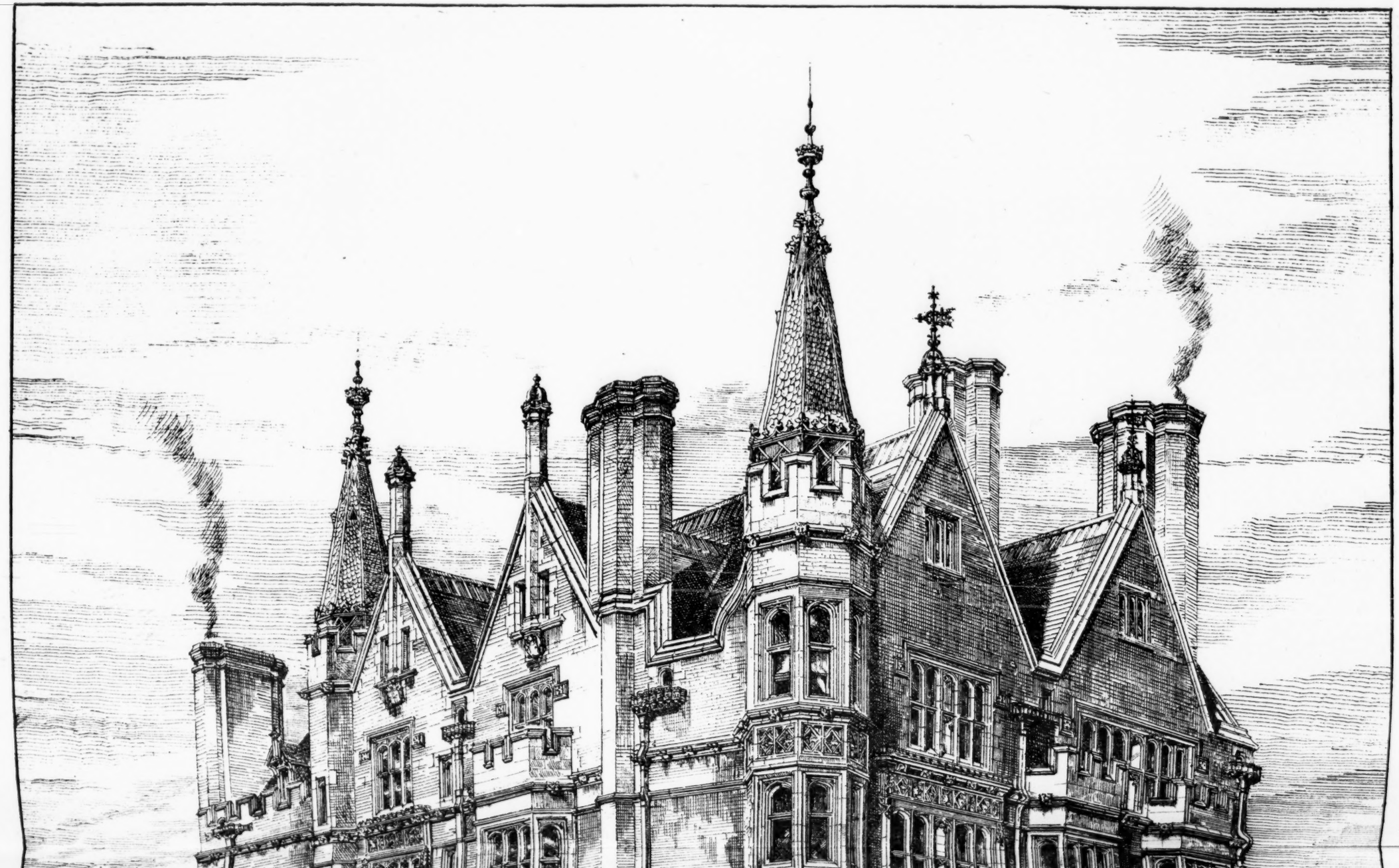
FROM the Portico of PHILÆ



10

EDFOV

COLVMNS and CAPITALS —— illustrating second lecture by Mr R Stuart Poole —— on "EGYPT" at the —— Royal Academy —— Feb.y 14. 1884.



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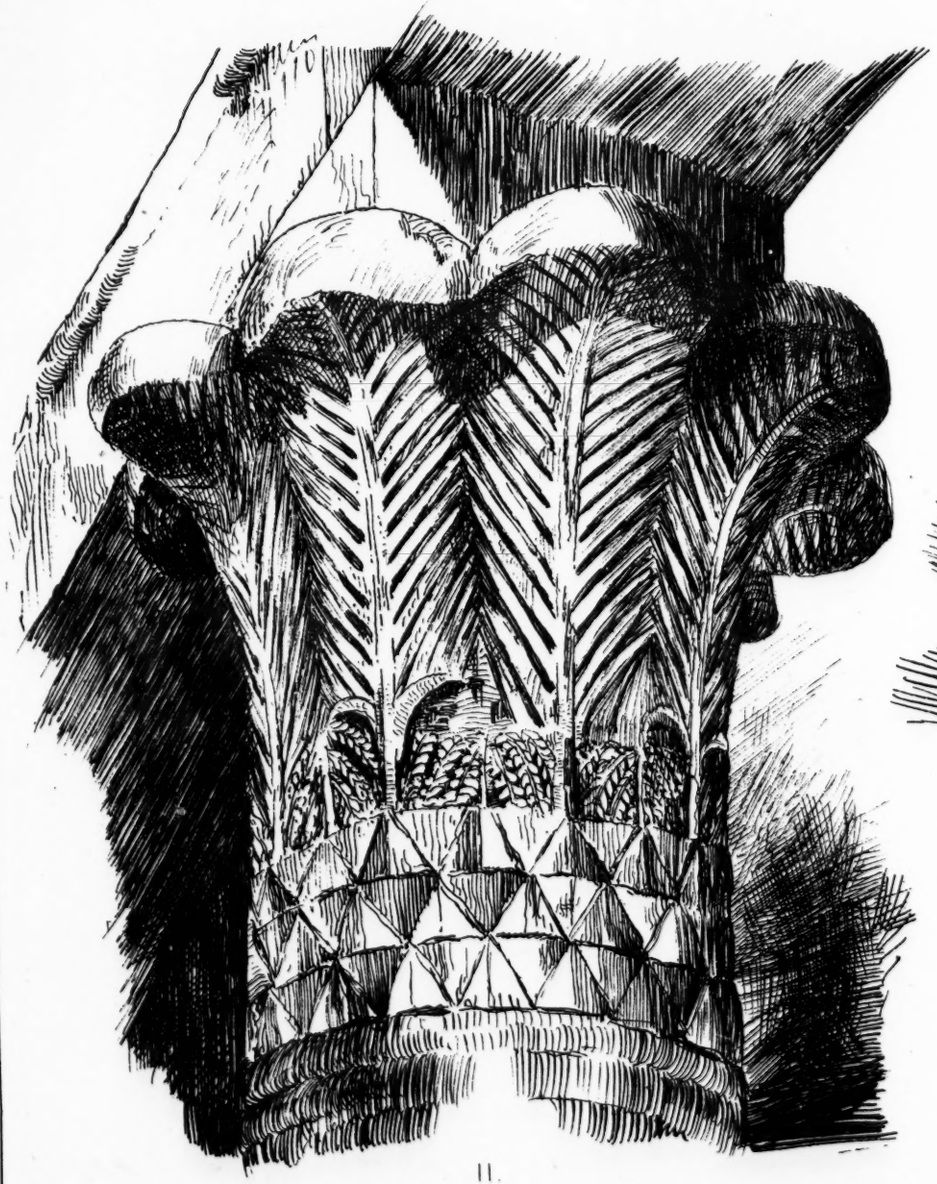
OFFICES AT SHEFFIELD FOR MESSRS. PAWSON & BRAILSFORD.

MESSRS. HADFIELD & SON, ARCHITECTS, SHEFFIELD.



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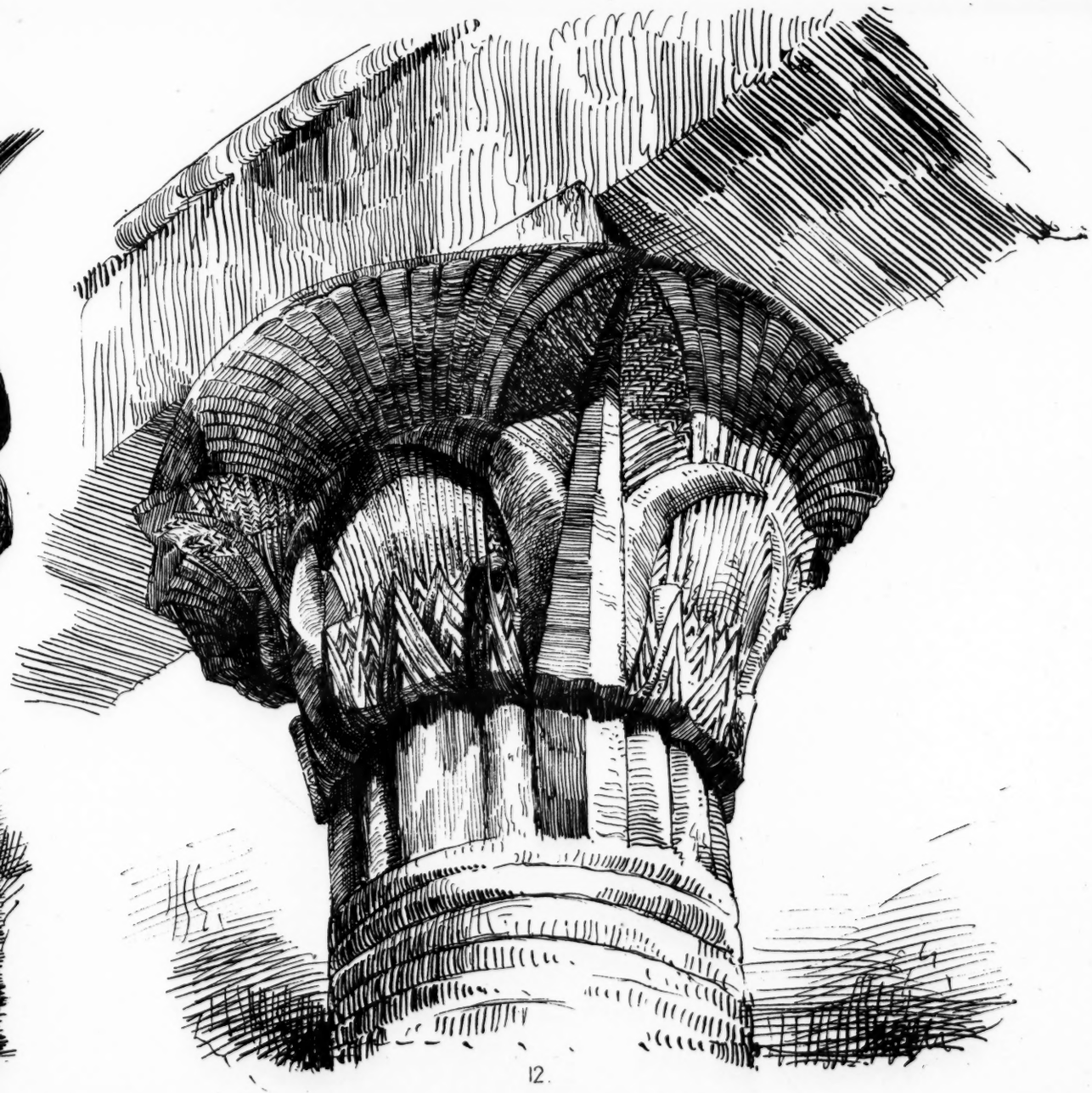

12.

Capitals · Philae · from · sketches · by · R. Phené Spiers. F.S.A.

A. Beresford Pite, delt.

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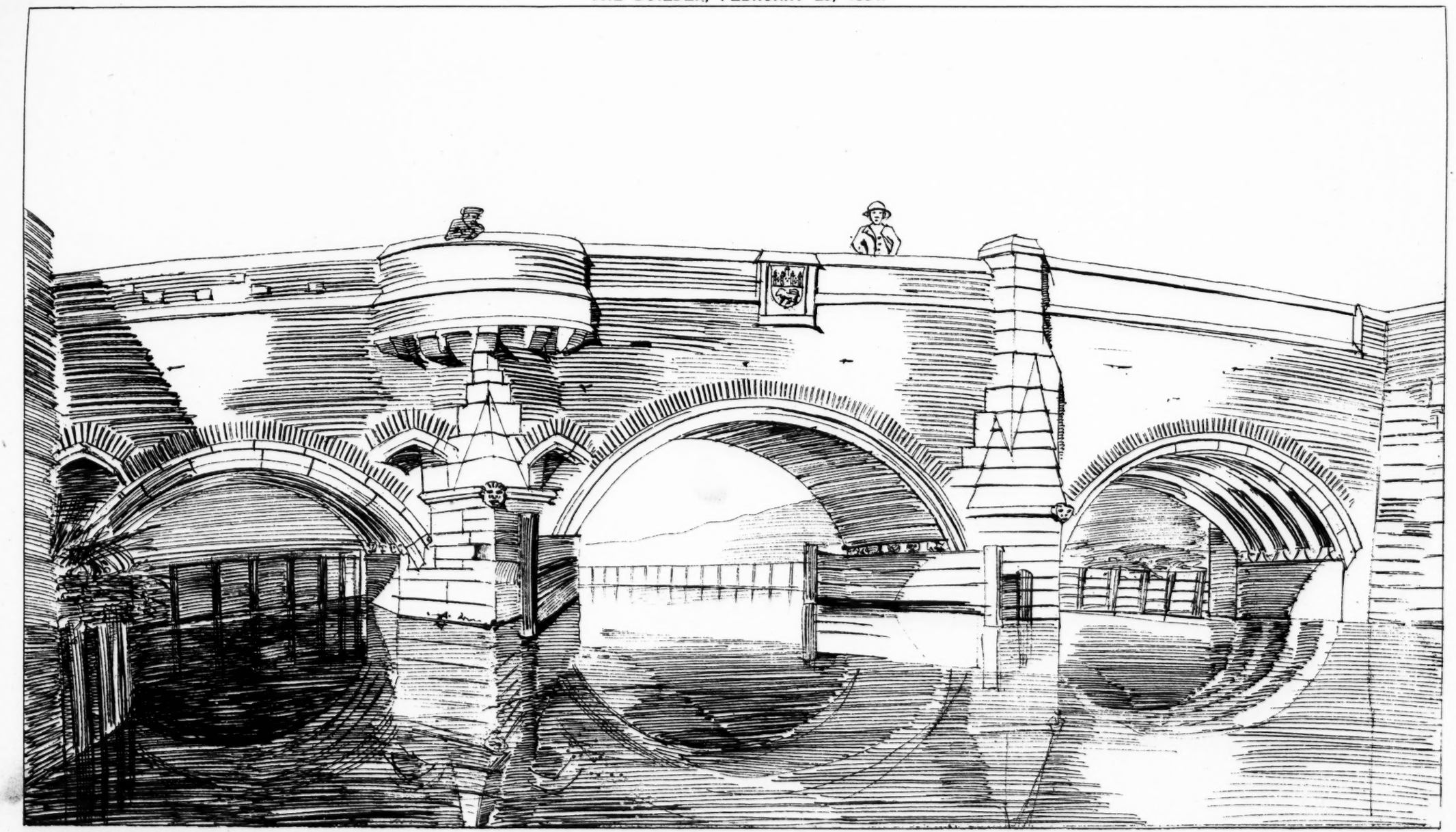

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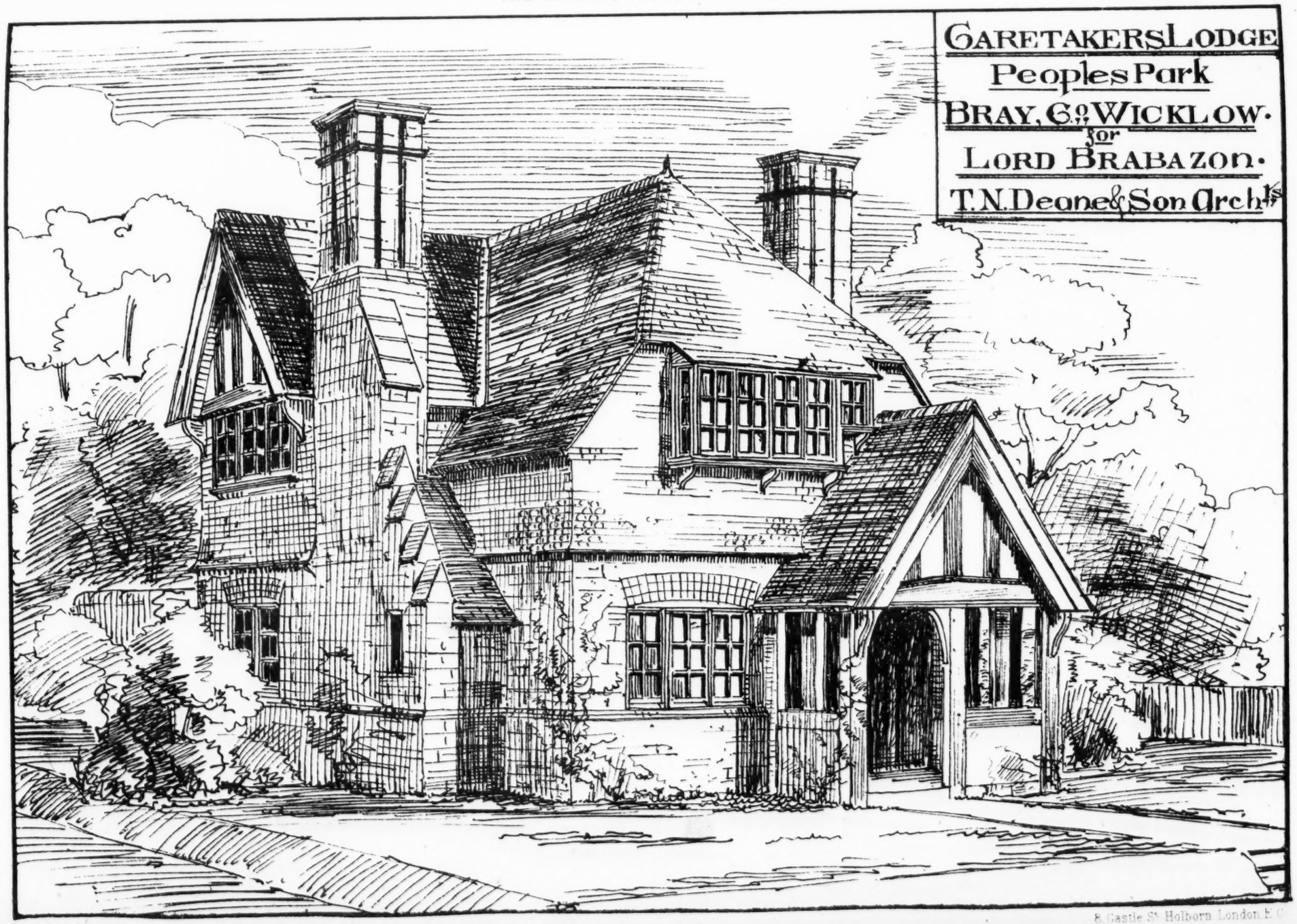
THE BISHOP'S BRIDGE, NORWICH.

R.I.B.A. *Pugin Travelling Studentship*, 1884.

J. GIBBONS SANKEY, DELT.



GARETAKERS LODGE
Peoples Park
BRAY, Co. WICKLOW.
for
LORD BRABAZON.
T. N. Deane & Son Archts

C. F. Kell Photo-Lith & Printer

8, Castle St. Holborn London E.C.

NEW PREMISES, CHURCH GATES, SHEFFIELD.

WE give this week an illustration of the above new premises now being erected at the corner of High-street and the parish churchyard, Sheffield, for Messrs. Pawson & Brailsford, the well-known printers, lithographers, and stationers. The site is, perhaps, the most commanding for business purposes in Sheffield, and great care has been taken to utilise every portion of the somewhat irregular plan, which we append to our illustration. On the ground-floor Messrs. Pawson & Brailsford's large shop will occupy the principal corner of the building, having one front to Church Gates and another to High-street. There are, in addition, two sale-shops fronting to High-street. The building has six floors, including the basement, which is commodious, dry, and well lighted. The principal floors are laid out in suites for offices for solicitors, accountants, &c., which are approached from East Parade. The buildings are constructed with Huddersfield stone and specially-made bricks from Fareham, Kent. The roofs are covered with green Westmoreland slate. The buildings were commenced last July by Messrs. G. Longden & Son, contractors, and it is anticipated that the first portion of the block will be ready for occupation about Midsummer next. A portion of the site is at present occupied by Messrs. Pawson & Brailsford for temporary premises; therefore the whole design cannot be carried out until their new shop is ready for occupation. The electric light has, we are informed, been used in Sheffield for the first time for building purposes by the contractors. Messrs. M. E. Hadfield & Son, Corn Exchange Chambers, Sheffield, are the architects, and the Clerk of the Works is Mr. George Webster. The carving has been entrusted to Mr. Frank Tory.

THE BISHOP'S BRIDGE, NORWICH.

THE sketch of this effective piece of Mediæval bridge-building is an example of the work sent in by Mr. J. G. Sankey, who, as we reported previously, has obtained the Pugin Travelling Studentship for this year. It is a good specimen of pen sketching, true in line, and free in general effect. We purpose giving one or two more of Mr. Sankey's sketches submitted in the same competition.

GARDENER'S COTTAGE AND LODGE.

THE views of these two small buildings are given as sketched by the architect, in a free but effective manner. Both are in Ireland. The gardener's cottage is at Balrath-Buiry, County Meath, and was built for Mr. C. A. Nicholson; the lodge is that built for the caretaker at the People's Park, Bray, County Wicklow, for Lord Brabazon. Both are pleasing examples of picturesque cottage architecture. They are designed by Messrs. T. N. Deane & Son, of Dublin.

MARBLE AND MARBLE MOSAIC.*

OF opaque coloured materials, marble is the most perfect, and it has also the merit of having the widest range of colour of any natural substance. Under marble I include all opaque stones that will take a polish,—limestones, dolomites, soapstones, porphyries, and serpentines; and I use the term opaque in its common sense, for not only is marble translucent, but all materials are when cut thin enough.

I have seen Faraday produce a beautiful green colour by letting light pass through a thin film of gold attached to colourless glass. Many of you have probably seen the windows of the cathedral at Torcello, glazed with some translucent stone, the alabaster windows at San Miniato, not to speak of modern windows glazed with Mexican onyx. What was the *lapis specularis* or *specularia* with which Roman conservatories were glazed? Was it really talc.?†

Mr. Tadema has obtained beautiful and surprising effects by using as stained glass thin films of marble.

Marble, being one of nature's choice productions, has many merits; it is strong, hard, and dense, will take the most delicate forms that are impossible in stone, and allow of this delicacy being seen. Much of the beauty of Greek work arises from the material used being marble; it takes a high polish, affords the least footing for dust, and is easily cleaned; it is variously and beautifully coloured, and, in many cases, its colouring has the highest attributes of nature's handiwork,—infinite variety,—for though we call one marble white and another black, and others red, yellow, grey, or green, it is almost always possible to find in a large slab a piece of the opposite or contrasting colour; in black, pure white; in white, pure black; reds in the greens, purples in the yellows, and in the variegated sorts which are the most common and more nearly convey the very notion of marble, we see an endless variety of tints and tones, and many varieties of colour. For this reason alone the use of marble is always the simplest means of getting good coloured effects; for nature has so varied its surface with vague but beautiful forms,—has so harmonised the colours, tones, and tints,—has given such sudden and brilliant surprises in the shape of contrasts, flowers, bands, stripes, patches, and spots,—that it is more than doubtful if the highest human skill can surpass them by painted ornament or coloured inlay. The lustre of the polish, the restrained tone of colour, the calm dignity of marble when used in large masses, is absolutely unapproachable.

Considering that there are forty different coloured marbles in the quarries at Siena, ranging from white to black,—that there are marbles in every division of the world's surface,—that in France alone about 600 have been already catalogued,—it would be quite impossible to give you the vaguest idea of their various merits in a lecture; but I may well dilate on a few of those that are commonly used in London, and on a few exceptional ones.

First, I may mention the imperial purples. You know imperial purple was of four kinds,—the amethystine; the Tyrian, of the colour of clotted blood; the Hysginian, or puce; and the crimson.

The first marbles in rank are the purple Egyptian porphyries, which are truly imperial from their fine colour, excessive hardness, and great durability; they will, moreover, take a polish like glass. Both purple and green Egyptian porphyry may be seen on Henry III.'s tomb in Westminster Abbey.

Lord Leconfield has two splendid table-tops of purple porphyry, formerly in Hamilton Palace. The altar-step of Lord Ripon's Church is of it, and plenty may be found in the Roman churches. In St. Mark's there is much, mostly stolen from the East by pious Venetians.

Still more splendid in colour is red serpentine mottled with dark green and black and flecked with gold, and no Imperial robe can exceed in splendour the dappled blood-red antique breccia of Numidia, nor the Griotte d'Italie, with its white veins and partridge eyes. The Rosso Antico, no longer antique since the quarries have been found in Greece, is of a deeper colour than the robin's breast, and looks as if light fingers had touched it here and there before the colour was dry; Languedoc, of a still more vivid red, powdered with flames of white; the Greek red, with fragments of pink and yellow embedded in it; the Cork red, speckled with white; the dusky red and grey of rouge royal; and red Devonshire. After these come the soft-coloured mottled yellowish-pink of Emperor's red and Verona; the deeper pink of St. Juan fretted with pinkish white; the brilliant Devonshire spa mottled with violet pink or brownish red; and the red-veined alabasters, of which the much-coveted alleys of our boyhood were made; but much more splendid alabaster is to be found in the English quarries, tinted with purple, not to speak of the pink granites and porphyries.

For yellows we have the lordly Siena, with its deep orange ground streaked with purple, veined with black, and here and there spotted with white; the pure yellow of Giallo Antico; the pale yellow of the Ivorio Antico of Numidia; the yellow Egyptian alabaster, with its eddying veins of white; Brocatello, which you may class with yellow or red, as in its fine brocade one or the other colour predominates; and the Rose du Var, light tawny yellow, with red marks.

Nearly approaching the yellows are some of the tawny marbles of Numidia, almost like skins of lions, glorified.

Of all the greens, some of the five Verd Antichi are the most splendid and the noblest Corsi names them the clear, the dark, the grey flowered, the small flowered, and the emerald.

We may see the dull sort in inlays on chimney-pieces of the last century, and it harmonises more admirably with the creamy white of old statuary than any other inlay I have seen.

Perhaps the most superb of all is the one that looks like a field of emerald through which meander streams of milk white, a mere streak in some places, mixing with the green, inclosing small black lines and fragments, and spreading out into wide lakes with minute veins of the green passing them, and the whole taking a gem-like polish. A table-top of this may be seen at Dorchester House.

Next to these come Genoa green, that looks like a black delta marbled by a thin snow-filled valley, cut through by pale green rivers full of black fragments; Greek green from Laconia, and the dark green Vert de Corse, Vert Maurin intersected in every direction with light green veins; the Campan Vert, like pinkish white almonds embedded in pistachio paste; the Campan mélange, of a full green streaked with red and flowered with white; the Cipollino, like a slice of green onion, though its name is said to be given from its smelling like an onion in the working; the Irish green, that varies from bold eddying streaks of dark grey, like Tartar clouds, to the pale yellow of spring leaves on trees in a water meadow, here and there interspersed with translucent spots of dark green, like seaweed seen through pools (fine specimens of the pale yellow green may be seen at the Geological Museum); the cool green marble of Anglesea, spotted with black and brindled with white; the green Egyptian and Irish porphyries; green serpentines, of which the dark bands on Italian buildings are made; the grey green and purple Purbeck and Petworth marbles, of which so many of the shafts in our Gothic cathedrals are made.

For white we have Carrara, Parian, and Pentelic, the blue-white Sicilian from Carrara too, but called Sicilian because it was first brought to England by the good ship *Sicilia*; the white granites, and snow-white alabaster, the pale and the deep-veined white marble, the white pavonazzo and pavonezzetto, with purple veins and the peach-blossom, the three latter fit for a princess's boudoir.

For black, Nero Antico, Irish black, Belgian black, English black, black basalt, and black granite, though this latter is grey.

For greys, the grey granites, dove, Belgian grey, the lovely pale grey Bardilla, with its network of darker veins and black rivulets, and blue imperial.

For black and white we have Hachette and Grand Antique. A shaft of the latter still shows one bit, finely polished by the shoulders of the faithful, in a doorway at St. Mark's; Belgian blue, and Nero de Seravezza, both veined with white.

But perhaps the most splendid marbles are those which can be put into no category of colour, the different sorts of variegated breccias, and, if you will allow the word, bigaroon marbles, the pale fawn-coloured Caserta, diapered with crimson patches, sometimes small like vine-leaves, with creamy-white stalks and tendrils, and sometimes in masses as big as your head, nearly resembling the false jaspers. The violet breccias from Rondone, with large round patches of purple, red, grey, and yellowish white, bound with dark-grey and black veins; the breccia of Palermo in which fragments of white, dark-grey, and pale yellow are embedded in a morone cement; the gorgeous antique breccias of Africa, where large masses of black, bluish grey, and flesh colour are joined by large veins of blood red and jet black; the grey Sarrancolin veined with red; the dark brown breccia of Belgium with black patches and red spots; the breccias of Septimius Bassus, of one of which the late W. Burges had a frustum. And all the antique breccias of Numidia; the Egyptian breccia, in which green and purple pebbles of porphyry start out from a golden ground, to be seen at St. Vitale, Ravenna, at the Campo Santa, Pisa, and as slabs on Louis Quatorze furniture; yellowish white jasper, with flaming bands of red purple and yellow across them; the red and white striped African serpentines of inky blackness spotted with pink, and others like a serpent's back, olive, green, and creamy white; deep flesh-coloured, steel grey, red, crimson, pink, green, and black porphyries; white serpentine, with black spots like black

* From a lecture by Mr. G. Aitchison, A.R.A., delivered at the Royal Academy on Monday, the 18th inst.
† See Martial, epigram xiv., lib. 8.

peas on a table-cloth, and the deep brown and white Californian spa.

From these I have omitted the gems and precious stones, lapis lazuli and malachite, coral, onyx, agate, real jasper, chalcedony, and bloodstone, rock crystal and carnelian,—all of which may be found used in the altar-pieces abroad; and let me say that the Mexican onyx is as lovely in Mr. Tadema's windows as it is livid on a wall.

Thanks to Il Cavaliere Giovani Battista we can see at the Natural History Museum many of the famed marbles of Numidia, and at the Geological Museum Corsi's slab, containing 1,012 specimens of antique marbles.

We want a Marble Museum, where we can find large polished specimens of all the known marbles in the world, so that when our people have shaken off their apathy for beauty we may see the riches we have to deal with. Supposing the building provided, it would cost but a trifle to form the collection. Every civilised country would be pleased to exchange polished specimens of their own marbles for ours.

It is not surprising that a people fond of stately magnificence, like the Romans, should have been so passionately fond of marble that the whole world was ransacked for the finer varieties, that the emperors should have taken some quarries under their special protection, and have almost restricted their products to Imperial use; that when a new and beautiful marble was found, a specimen should have been set up in the Forum and greeted by the people as with a triumph; nor that vast sums should have been lavished on the purchase of a single column. What does strike one as surprising is the utter insensibility to the beauty of marble that the English have shown. We may say that till quite lately the use of marble, beyond statuary, has been restricted to hall-floors, chimney-pieces, and the tops of wash-hand stands, if we except a few monumental slabs.

Most marbles lose their due effect when not used in masses. Their restrained tones harmonise with their own varieties; but when they are in small pieces they are obliterated by the general tone of fully-coloured rooms. This may be particularly noticed in the case of chimney-pieces, and has greatly tended to the frequent use of white, which truly attracts the eye, but destroys the harmony of the whole room; still, if the room be white, or some very light tone of colour, the richer coloured marbles may be used effectively as jewels. Polished marble harmonises badly with a rough or dusty quality, such as that of distemper or fresco, brick, and stone, but goes well with glazed tiles, burnished metal, polished woodwork, glass mosaic, and with the richer qualities of oil-painting. Even when using the fuller coloured marbles of one tone much moulding or ornament is thrown away, and it is positively ludicrous to use these when the marbles are richly variegated and of large figure.

I may here mention that though marble is one of the hardest materials it is also one of the most treacherous, and that almost all variegated and flowered marbles are full of flaws, cracks, vents, and veins and sand-holes; this does not much matter when the marble is used for casing or for columns that carry no weight, but when we build monumentally, discard iron and lath and plaster, and let our columns carry arches, vaults, and domes, no column should be used without careful examination and subsequent testing by the press.*

The New Pauper Lunatic Asylum, Exeter.—The Town Council met on the 13th, and decided to accept the tender of Messrs. & Co., of Chudleigh, near Exeter, for the terra-cotta. The amount was 3,523*l.* There were six other tenders, which ran :—

Jennings	£6,563	3	3
Johnson & Co., Ditchling	6,239	15	0
Gibbs & Canning, Tamworth	5,316	0	3
J. C. Edwards, Ruabon	4,491	9	9
Hathern Station Co., Loughborough	3,525	16	0
Doulton & Co., Lambeth	3,525	0	0

the eighty applicants for the post of clerk of works (salary 3*l.* 3s.) Mr. D. H. Green, of Shrewsbury, was selected. The names of Councillors Harry Hems and George Packham were also added to the Building Committee. The general contractor is W. H. Phillips, of Exeter. His price is 56,200*l.* The architect is Mr. R. S. Wilkinson, of Furnival's Inn, London. Mr. Wilkinson is the son of the present Mayor of Exeter.

* Mr. Aitchison thanked Messrs. Boucneau, Burke & Co., Messrs. White & Sons, and Mr. Robinson for the loan of fine specimens of marbles to illustrate his lecture.

THE VENTILATION OF THEATRES.*

PARKES MUSEUM OF HYGIENE.

ANOTHER advantage of the *plenum* system I am advocating,—that depends upon an ample supply of air forced in rather than upon means of exhausting the vitiated air,—is that all those ugly cowls, which you must have noticed are my special *bêtes noires* become needless. A tax ought to be put upon every such excrescence in proportion to its size and unsightliness; and this tax should be quite prohibitive of all such monstrosities as those that disfigure the roof of St. James's Hall, and make London a laughing-stock to foreigners, who pay a little more attention to the beauty and skyline of their streets than we do to ours. We should then see the last of those metal pipes which obtrude from our roofs, looking as if they had sore throats wrapped round with comfortless "comforters," and which, in pretty little models, seem sometimes to extract air with marvellous ease, but which somehow generally fail to do so when most needed, as, for instance, when there is no wind to blow, or when it may happen to blow alittle too hard.

The system is applicable, at moderate cost, to old theatres, as well as to new ones, and, of course, it is our oldest theatres that stand most in need of being ventilated, since most of them are but death-traps to all concerned with them, —audience and actors and supernumeraries. It would, perhaps, be invidious in me, who, as an architect, cannot have any interest whatever in any of the numerous patent and other inventions for ventilating appliances which are offered to the public, to specify which of them I should particularly recommend.

I am not able to speak much from personal experience as to the condition of theatres on the Continent, in regard to their ventilation, but I think it may be assumed that the general experience there is much on a par with that here. In the *Builder* (a journal which has always been a strenuous advocate for sanitary reforms) for Sept. 22, 1883, the following statement appeared :—

"As for the matter of ventilation, that also requires, in the interests of the public, most earnest consideration. There at least we have but little to learn from our Continental neighbours, who suffer in their theatres quite as much as we do in ours. The day that the last grand chandelier shall have disappeared from our theatres will be a memorable one in the history of the stage. Then at length a visit to the theatre will cease to be what it, at present, too often proves,—a singularly uncomfortable mode of enjoying one of the most instructive of all pleasurable relaxations."

We may, I think, turn with greater advantage to consider the attempts that have been made in America, where, necessarily, from its climatic extremes, the subject of ventilation has been much considered. This has been described in a paper by Mr. Arthur J. Gale upon American architecture, published in the Transactions of the Institute of British Architects for 1882–83. These seem to show that ventilation upon, as far as I can judge, the identical general principles that I have laid down, has been successfully carried out in the Madison-square Theatre in New York. Mr. Gale says that this is not a very large, but a very successful house. He then describes it as follows :—

"The fresh-air inlet is by a descending flue, 6 ft. square, lined with wood, in which is a conical cloth bag, 40 ft. deep, to filter the air, which afterwards passes over ice in summer, four tons being used each night, two tons before and two after the air passes the fan at the bottom of the inlet-shaft; this fan forces the air into a brick duct, from which sheet-iron pipes lead it into four brick casings surrounding steam radiators that supply the required heat in winter. This fresh air, so regulated in temperature, is conveyed by 4-in. tin circular pipes to the four sections of ninety seats each, in the auditorium. Other special ducts supply additional cooled air, when needed, to other parts of the building. All the gaslights are encased in glass, and have ventilating shafts. By these and other exhaust-shafts the vitiated air is drawn off from various parts of the building by means of another fan in the roof. The footlights are ventilated by the same means. Tests have proved the ease with which the system can be worked, and the excellent results which have been attained by it. The temperature, on one occasion at 9.30 p.m., was, outside, 85° Fahr.; in the delivery, just beyond the ice, 70°; and at the main outlet, 86°.

Having now cited this record as to the manner in which a theatre has been successfully treated, I need say no more in support of the general principles that I have advocated. As to the special appliances which are required to carry them out in practice, they must necessarily vary according to circumstances. I shall conclude, therefore, with the recommendation to managers to give the thorough *plenum* system proposed a fair trial, and not to be content with half measures, and to be cautious not to allow themselves to be led, or rather misled, by the specious advertisements of patentees of particular appliances, the value of which, if any, depends entirely upon the manner in which they are employed. In all cases they would be wiser to place this class of work into the hands of a professional man in whom they have confidence and whose reputation would depend upon the success of the result as a whole, and who, of course, has no interest whatever in anything that would form merely part of the details of the general arrangement.

Since the foregoing was written my attention has been called to a description of another American example, that of the ventilation and warming of the Metropolitan Opera-house of New York, given in the *Sanitary Engineer* paper of that city for December 6th of last year. The system adopted seems to be exactly what I have recommended, and to have been designed and carried out by the architect, Mr. J. Cleveland Cady, and the ventilating engineer, Mr. Frederic Tudor. The principle involved is stated to be that of "plenum ventilation," the object being to have an excess of air entering the building to that which is leaving it by the regularly-provided foul-air outlets, the result of which is to have a pressure within the building slightly in excess of that of the air without the walls, so as to insure an outward current through crevices of doors and windows or accidental openings. To accomplish this in a practical manner a blowing-engine is used, and the supply of air is almost unlimited. There is a principal controlling valve to the ventilation in the centre of the dome-shaped ceiling of the auditorium. By the adjustment of this the pressure within the house is regulated, and the condition of *plenum* maintained under varying conditions of the speed of the fan.

In the Prince's Theatre, recently opened and built by Mr. Phipps, as at the Savoy, the basement, the most difficult portion of a building to ventilate, has been efficiently ventilated and warmed by the "Æolus Water-Spray Company." This system affords ample power to completely warm and ventilate any building, and no doubt there are others that can accomplish the same end. It remains for architects and their employers to make proper use of the means now placed at their command.

The comfort and health of the actors and *employés* at theatres would, no doubt, be very greatly enhanced if in their dressing-rooms, which, as a rule, are wholly neglected, and consequently in a parlous condition, a few simple precautions were taken, such as, indeed, should be adopted in rooms of all buildings. These are the provision of a supply of fresh air to every fireplace or stove, and the extraction of the foul air from the separate rooms by outlet ventilators into the smoke flues. There are numerous excellent appliances for this purpose in the market, such as Boyd's, Shillito's, and other ventilating-grates now generally used in school-buildings.

There are plenty of admirable appliances in this Museum and elsewhere for the construction of the several parts of buildings and for the consumption and extraction of smoke, but it seems to me that the public generally does not recognise their utility, which I think arises from the isolated manner in which they are separately brought into notice. It is to be hoped that in the forthcoming Health Exhibition at South Kensington this may be remedied. I may say that I am taking steps myself to give practical outcome to the opinions I have myself formed on some of these subjects by the assistance which has been kindly offered me by a firm (Messrs. Belham, of 155, Buckingham Palace-road), and I hope to be able to show that such practical requirements may be provided for without such an absolute sacrifice of the artistic, as we have become unfortunately too accustomed to, by the multifarious cowls which now disfigure the majority of our buildings.

In the discussion that followed the reading of the paper,

The Chairman (Mr. George Godwin, F.R.S.) said the question of the ventilation of theatres was a very important one, as every person in

* A paper read by Mr. J. P. Seddon, F.R.I.B.A., at the Parkes Museum of Hygiene, Margaret-street, Regent-street, on Tuesday, Feb. 12. See p. 225, *ante*.

the room would admit, and therefore they were all obliged to Mr. Seddon, whether they agreed with all he had said or not, for having brought it forward. He would have liked to see some few managers and some few actors present, as they might have given the meeting the benefit of suggestions on the subject. It was not an easy one to treat. When the Opera-house in Paris was commenced, a Commission was appointed consisting of General Morin and the best men who had studied ventilation, to decide how the question should be dealt with, but after sitting for a long time the Commission broke up in despair, and it was left to Monsieur Garnier, the architect, and one engineer, to carry the matter through, and they arrived at the conclusion that little was to be done, except to open some large windows now and then; and, unfortunately, that was just what most of our managers of theatres did. He was unable to agree with Mr. Seddon that the new theatres in London were an improvement upon the old ones in this respect, for some of them were abominable (there was no other word for it). They committed murder. On the night of the opening of the Comedy, for instance, an acquaintance of his attended, and was in bed a month after with lumbago. At Covent Garden Theatre, during the pantomime, when the curtain was up, there was not a draught merely, but a high wind; and it would be impossible to say how many persons every night went away from the theatres with colds. In the dress circle of Drury Lane Theatre the end door was always open, and the attendants did not care for any observations made about it. That these arrangements produced illness there could be no doubt. It was not pleasant to speak about these things, but the time had come when some one must speak about them. The new theatres were built with the back of the dress-circle towards the street, and when the street doors were opened the cold air passed through the dress-circle and other parts, and caused great mischief. He was afraid architects did not devote sufficient attention to this matter. They seldom or never attempted to warm the air even in the simplest way, as it might be warmed, before entering the theatre. Mr. Rice some years ago introduced fireplaces here and there, and in the staircases, with a view to produce some little amelioration; but they were utterly useless, owing to the unsuitable construction of the stoves. The better plan would be to make some provision for ventilation in the lower part of the house before the theatre had been completed. He was sure that something might be done,—in fact, something would be done, if managers were wise, because steady-going play-goers were gradually being driven away from the theatres more by draughts than by bad air. The *plenum* system which Mr. Seddon has spoken about would be excessively difficult even when constructed *ab initio*. Whether the electric light might enable the managers to lessen the draughts he did not know, but, at any rate, managers might devote attention to that subject. In so well-conducted a theatre as the Gaiety, in the upper boxes, there were windows which were opened at intervals, no matter what the temperature might be, by the attendants, who had their instructions to do so and could exercise no discretion. An enormous amount of annoyance was thus caused, and, so far as he knew, there was no attempt whatever made in front of the house in any theatre in London to avoid these dreadful draughts. Bad air was bad enough, and he had done his best to show that during the greater part of his life, but it was not so quickly bad as draughts. They might have met with the Hindoo saying that a draught was a serpent. The Hindoo knew well what a draught could do. There was a saying among English people about draughts:—"If you get the wind through a hole, Make your will and mind your soul." But bad air did not act so quickly, though it was bad enough. Our theatres as a rule,—and especially our new theatres,—were positively a disgrace. He did not wish to say a word against the able architects who had constructed them. They could not help it because they were tied down to spend only a certain amount of money, and limited by a little slip of land, often between two other houses, in which they had to place the theatre, and they had to do the best they could; but, in many respects, instead of being better than the old theatres they none of them approached Drury-lane Theatre; they appeared to be built only as a means of investment,—something which would bring so much money to the managers and actors,—for there never were such times as the present for lucky managers and clever actors. In consequence they had got this notion into their heads,—more than one had told him so,—that if it was a very good piece the public would come and be killed; and if it was not a good piece, however well they might ventilate and arrange the theatre, the public would not come at all. Therefore, it was time the public should look to themselves. Some were present who some years ago endeavoured to obtain for London one theatre at least which should not be wholly regulated by the prevailing popular opinion, and they hoped some day that that effort would have effect, and that they might have for the exhibition of their classical drama,—the finest and grandest drama, perhaps, of any country,—a theatre in which these deadly draughts might be prevented. He would ask the meeting to pass a vote of thanks to Mr. Seddon, and he trusted his excellent paper would lead to the matter being considered elsewhere.

Mr. Hermann Vezin agreed that there would be some difficulty in carrying out the *plenum* system, unless the machinery could be put on the roof, because the theatres, as a rule, were so small. The description given of the Madison-square Theatre in New York implied a larger space than the London theatres possessed. At one time he constantly urged upon managers of theatres the importance of ventilation, until at last they all told him it was a craze he had. He had that afternoon been to the Lyceum Theatre, and had come away with a headache, and probably most of the 2,000 people there had done the same. A remedy might be found, he thought, at comparatively small cost. There was a certain amount of truth in what had been said by the chairman, that the public "would go to the theatre and be killed," if there was an attractive piece; but he believed if the theatres were well ventilated, the public would go in larger numbers even to see a moderately good piece. He seconded the vote of thanks.

Mr. Hebb said that the *plenum* system had already been applied in one or two instances,—in one case to a theatre,—and had not been successful. It might be urged that in the case of a theatre the plan of the building was exceptional; but he had known the system tried in several large buildings, and the verdict was adverse. There seemed to him to be more chance of success in the natural system of admitting fresh air by conduits, and leading it to some large receptacle where it could be warmed, and then diffused by means of pedestals placed in convenient positions. The difficulty in regard to theatres was that they had to deal with several tiers; but that was one that might be got over by the natural diffusion of air brought into the building, and allowing the vitiated air to escape by means of the central gas-burners or other openings if they were required. But the first thing to consider was whether the public wanted such ventilation. He rather fancied they did not, or they would have cried out for it long ago. The foreign theatres were no better than the London ones in regard to ventilation, because the legislation was permissive; and the majority of the managers were content to warm and ventilate their theatres by means of the bodies of their audience. Such a system was, of course, disgraceful. Some twenty years ago it was resolved to apply scientific principles to the ventilation of the two theatres on the Place de Châtelet in Paris, but after a time it was found to be unsuccessful and was discontinued. In one of those theatres the cost was 5*l*. per seat and in the other 2*l*. per seat. No manager could be expected to incur so large a cost of his own accord, and therefore if the public required it they would have to insist upon it being done.

Dr. G. V. Poore suggested that in our climate the natural means of admitting air would, for the most part of the year, be sufficient; but in the modern theatre there was no place arranged for the admission of the air. It might, however, be admitted to the corridors outside the dress-circle where it would get warmed, and might thence be admitted through Sheringham valves to the dress-circle itself. He would like to hear the experience of actors of the effect on them of non-ventilation, and the effect it had on the voice. The cause of failure in our singers he believed to be due more to foul air than to draughts. People caught cold not so much through draughts as from being prepared to catch cold by sitting in foul air for hours before they came into the draught. He thought the ventilation of theatres might be improved if managers would go to the expense of knocking out a few bricks from the walls.

Mr. Liggins said he had never been in a worse theatre than that in Madison-square, New York. In the two theatres on the Place de Châtelet in Paris, there was no attempt at ventilation. In the Paris Opera-house the ventilation never reached the audience, and he had made up his mind never to enter it again. He had been twice to the Savoy Theatre, but should have gone twelve times if it had been better ventilated. All the modern theatres in London were equally bad in that respect. It appeared to him the only system to be adopted was to introduce fresh air and draw off the foul air by artificial means. He believed there were too many systems of ventilation before the public, and the proper plan would be to fix, through the medium of this institution, on one of them,—the best one,—and then say, "This is the system that will ventilate a theatre."

The Chairman observed that it was bad enough to have windows opened and fastened, but they might sometimes be closed; but if they had bricks knocked out of the walls and holes left, which could not be closed, it would be much worse. He then put the vote of thanks to Mr. Seddon, which was carried.

Sir Joseph Fayrer proposed a vote of thanks to the Chairman, and having heard the London theatres entirely condemned on the matter of ventilation, he thoroughly agreed in all that had been said. In regard to a resolution which had been proposed by a previous speaker as to the constructional defects of theatres, he hoped an opportunity would soon be found to reconsider it.

The vote of thanks, being seconded by Professor Hayter Lewis, was carried, and the proceedings terminated.

ARCHITECTURAL ASSOCIATION.

AT the ordinary meeting of this Association, held on Friday, the 15th inst., Mr. Cole A. Adams, the president, occupied the chair.

The following new members were elected, viz., Messrs. B. F. Fletcher, H. S. Wood, J. G. Jones, W. T. Gargery, W. B. Dawson, J. D. M. Crawley, J. M. Watson, and F. W. Potter. Mr. J. D. Sedding was also elected, without the formality of voting, as a distinguished member of the architectural profession.

On the motion of the hon. sec. (Mr. Appleton) a vote of thanks was passed to Messrs. Ernest George & Peto for allowing the members to visit some new houses in Harrington Gardens, as mentioned in our last.

It was announced that the next visit of the members would take place on the 23rd inst. to the Albert Exhibition Building at Battersea.

Mr. L. H. Isaacs then read a paper on "The Local Government of the Metropolis, its Relation to, and Effects on, London Street Architecture."

The general argument of the paper was to the effect that the Local Governmental Authorities were not elected on any principle or method likely to lead to the selection of persons capable of dealing well with the architectural improvement of our streets, and that the results were as bad as might have been expected. The Holborn Viaduct had been a mistake to begin with, as the valley, in Mr. Isaac's opinion, ought to have been filled up bodily, according to the suggestion of the late City Architect, Mr. Bunning; and the buildings on the Viaduct, which had promised well, had subsequently got into the hands of building companies, who vulgarised whatever they touched. There was little or no improvement over the results obtained years before by Sir Robert Smirke in laying out Moorgate-street and King William-street. The Metropolitan Board of Works had done a great deal in street improvements, in the way of forming new streets; it was only when the new street came to be flanked with buildings that we had cause to complain of the sin of omission, in the absence of any control over the style of buildings erected, and the erection of dull, gloomy buildings, as in Victoria-street, Westminster, and of still worse and indeed hideous designs on other sites which had been acquired at immense cost. In contrast with this, again, we had made no progress for the better since Nash laid out Regent-street, which was superior in effect in this respect at least, that the height of the buildings was in a moderate proportion

to the width of the street, and did not block out all the sky from it.*

In the discussion which ensued,

The Chairman said that the feeling which the paper left upon his mind was one of sadness, when they thought of the Slough of Despond into which the architecture of our great cities had fallen. All who had crossed the "silver streak" knew how much better these things were managed abroad. But Bumbledom could be traced everywhere in connexion with our statutes and buildings. It was a most difficult thing to give a remedy for all this, and it seemed to be only possible under some autocratic form of government.

Mr. W. H. Atkin Berry, in proposing a vote of thanks to the lecturer, said that Mr. Isaacs, from his official capacity as Surveyor to the Holborn District Board of Works, was especially able to treat the question he had brought forward. He should like to have some further information as to the nature of Mr. Bunning's proposal for filling up the Holborn Valley.

The vote of thanks having been seconded by a member,

Mr. L. C. Riddett remarked that some of the statements of the lecturer seemed to point to the fact that the system of leaseholds was answerable for a good deal of the unsatisfactory character of London architecture. Whatever the municipal bodies wished to be done, they could only grant a lease for eighty years. The Building Act was also answerable to a great extent for cutting off, as it did, all picturesque projections, which were so charming in Continental cities. He had hoped that the "Queen Anne" revival would improve the façade of the streets, and if it had given nothing but red brick it would be much to be thankful for. A great deal more could be done with colour. The colour of the red brick lasted much longer when gauged, as in the case of the old Inns of Court, and where this was not the case it became a picturesque purple. The white Suffolks on the Holborn Viaduct were dreadful. Perhaps the *crux* of the question lay in the composition of the municipal bodies themselves, and doubtless Mr. Isaacs did not like to deal too strongly with their *personnel*. The laying-out of streets, and the formation of parks and boulevards, required the attention of cultured men, accustomed to take broad views, while unfortunately those elected to serve upon public bodies were oftentimes sent there principally to see that the rates were reduced. He did not look forward with hope to what any new municipality would do for the metropolis. If they were to have a body elected, much as the School Board were, by an enormous constituency, it would not improve matters. If London were to have a new municipality, he hoped that the nobility and gentry would serve upon it, and help to do something for the architecture of the metropolis.

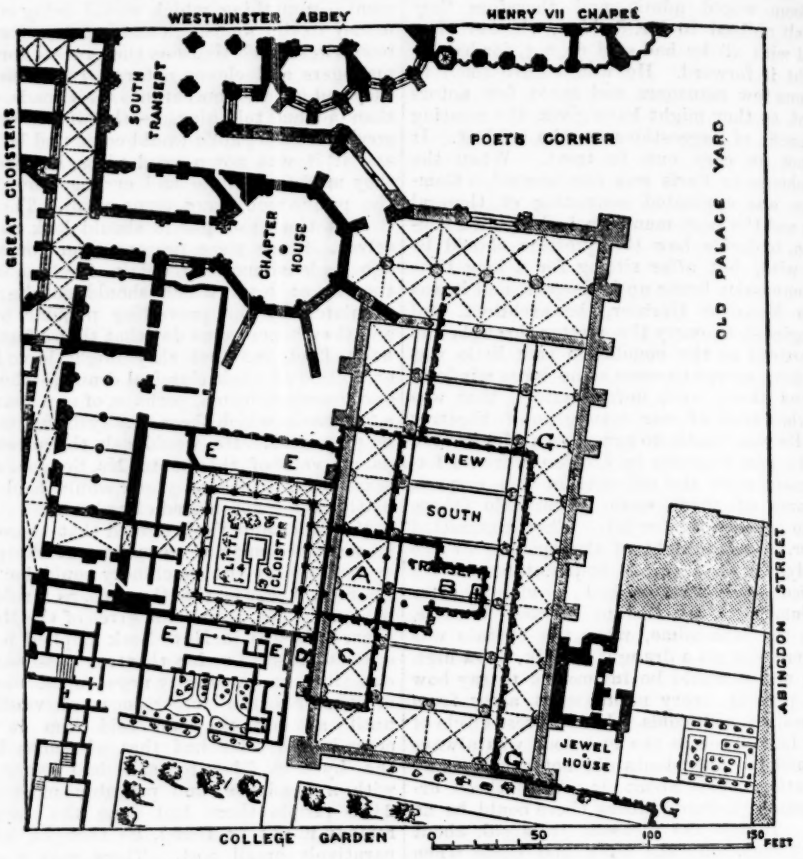
Mr. C. H. Brodie referred to the overhead telegraph-wires, and stated that in the case of the new railway works under Whitechapel and Mile End, he did not notice any provision for pipes or wires being carried through a separate tunnel.

Mr. Hunter said that the great point was,—who was responsible for the present state of things as regarded architecture in the metropolis? It was generally admitted that the *personnel* of the local boards in London was not of so high a standard as could be wished, and he believed that absenteeism had a good deal to do with this. As a rule the inhabitants of any particular district did not take a personal interest in its government. Through the system of leaseholds there had arisen a divided interest in the class of buildings to be erected. Even in the case of Northumberland Avenue people would not submit to advice in matters of taste, and he could not see that any mere re-arrangement of the government of the metropolis would set things right. This could only be done by developing the public taste, which they must wait a long time for in this country.

The Chairman then put the vote of thanks, which was carried by acclamation.

Mr. Isaacs, in replying, gave some description of the manner in which Holborn Valley might have been dealt with by a general filling-up; and in regard to what Mr. Brodie had said as to the Whitechapel-road, and the provision for wires, said he would make a note of it, and make inquiries into the matter. With regard to what had been put down to the leasehold system, in every one of his cases, which were under the control of the Metropolitan Board of Works, the right was given to secure the freehold for a given number of years' purchase within a certain time. Therefore they had to look beyond the absence of freehold as causing those architectural disfigurements, and he could only suppose that the cause was the absence of that control to be met with abroad. Was there not some middle course which, while sparing them from monotony on the one hand, should save them from the disfigurement of the leading thoroughfares through the absence of proper control? He could not help repeating that over and above the interest they felt in this question as ratepayers, as architects they felt a greater interest, because it had a vital effect upon the architecture of the entire city.

* Mr. Isaacs seems to have forgotten that the increasing demand for space and consequent value of sites in London absolutely necessitate an increase in the height of buildings. We cannot spread out laterally much farther,—we must go up vertically. The buildings in Victoria-street are certainly depressing and gloomy in effect, but it is not their height that renders them so. *Au reste*, considering the demands on our space, we have felt obliged to decline printing *in extenso* a paper which, though pithily expressed, only went to show that "whatever is, is wrong," without pointing out a remedy.—ED.



Sketch Plan showing Mediæval Buildings interfered with by Mr. Fergusson's Proposed Addition to Westminster Abbey.

WESTMINSTER ABBEY: PROPOSED "CAMPO SANTO."

SIR,—The letter from Mr. Fergusson on the above subject, published in your last issue, is one that cannot be passed over by those who care for the matchless interests, both archæological and architectural, which centre in Westminster Abbey, and the venerable buildings attached to it. Mr. Fergusson's letter gains importance from the fact that it is the outcome of the proposal for "a monumental chapel" made by the First Commissioner of Works in a recent article in the *Nineteenth Century* Review.*

That the Abbey is already overcrowded with monuments cannot be denied, and any scheme which may provide room for time to come without the destruction of things built by our ancestors in time past is deserving of the fullest consideration.

The schemes of Mr. Shaw-Lefevre and of Mr. Fergusson are, however, of the most destructive character. It is true that the parts of the monastic buildings which they condemn are not seen by every Cockney who visits the Abbey. When, however, a professed archæologist like Mr. Fergusson seems practically ignorant, or certainly careless, of these interesting fragments, the matter should not pass in silence.

To Mr. Fergusson's plan, published last week, I have added, with a serrated line, the Mediæval buildings which would be destroyed by the scheme. Some parts of these buildings remain absolutely entire, other parts in fragments, and of some portion we have left but the foundations. I must explain the lettering:—

A. The nave of St. Catherine's Chapel, which was the chapel of the infirmary.

B. The chancel, with the altar still *in situ*. Considerable portions of the chapel are complete; parts are incorporated with a "second-class residence," to use Mr. Fergusson's words, whatever they may mean.

C. The Infirmary Hall. This building is absolutely complete, including its roof. It, too, is incorporated in one of the "second-class clerical residences." The hall is in all respects as interesting to those who have any acquaintance with the subject as the Jerusalem Chamber or the College Hall.

Canon Prothero would have his "second-class residence" about his ears, as it lies to the east of the hall. It is not shown on the plan as it is not Mediæval, but it has about it much good post-Reformation work.

D. The slype, or passage, leading from the Infirmary Cloister (marked on the plan as the little cloister) to the College garden. This is the old passage-way, and would be destroyed in constructing the so-called "New South Transept."

E E. The houses surrounding the Infirmary Cloister. These were originally a series of small houses for the aged and infirm monks who lived under a relaxed rule. The doorways to the respective houses remain, and a considerable amount of the Mediæval work is incorporated in the existing residences, which, in their present form, are as much a part of the archæological and architectural growth of the Abbey and its buildings as were the original houses.

Those only on the north side of the Little Cloister are condemned by Mr. Fergusson. Not less, however, than five residences in all would be done away with by this scheme, and at least three by that of Mr. Shaw-Lefevre.

One interesting old house has just been pulled down by the school. Ashburnham House was not far from suffering the same fate. Can we spare more?

Where, too, are the occupants of the five houses to be placed?

Mr. Fergusson will leave us an Abbey, and

* *The Nineteenth Century*, No. 83, January, 1884, p. 47.

unlimited accommodation for the illustrious dead of the future; but there will presently be no man left to bury them, or serve the church.

F G G. The boundary-wall inclosing the Abbey and its garden now existing.

SOMERS CLARKE, F.S.A.

Feb. 16, 1884.

SIR,—Will you allow me to rectify a misconception you have inadvertently fallen into in the remarks you made on my proposed addition to Westminster Abbey in your last issue.

You express surprise that I should advocate a sham wooden vault for such a situation; but this is exactly what I have not done. It is true I have frequently spoken in disparagement of the wooden roofs, which are only too frequently found in our Mediæval cathedrals and churches. But it has always been with reference to those you deprecate so strongly, which simulate stone vaulting. On the other hand, I have always admired and spoken with praise of those wooden roofs which are formed with trusses or panels, in forms appropriate to timber construction. I believe them to be among the most beautiful and certainly the most characteristic features of English mediæval architecture.

In the present instance I proposed a roof composed of six hammer-beam trusses. It is so represented in the woodcut which accompanied my letter, as far as a plan can express such forms, and to make my meaning clear I referred, in my letter, to the roof of "the neighbouring Hall." A reference to its beautiful roof was, I thought, sufficient to explain what I meant. But what I really had in my mind was the beautiful roof, which, I believe, once adorned St. Stephen's Chapel, from which, I believe, the roof of the Hall was copied.* It was, I believe, the gem of English Mediæval art, and if any architect could now succeed in restoring it, in any church or chapel he is building, he would do more to illustrate the perfection of the art as it was practised in England in the best age, than by any means I can conceive.

What I proposed was that this should be attempted in my suggested addition to the Abbey, and if carried into effect with even a moderate amount of success, it would, I believe, be a far more beautiful and appropriate form of roof than such a stone vault as the late Mr. Street has erected in the New Law Courts, and might be made quite as permanent. Without its wooden covering a stone vault is a singularly unstable affair, as so many of our ruined abbeys can testify.

JAS. FERGUSSON.

20, *Langham-place, Feb.* 18, 1884.

*** On looking again at Mr. Fergusson's letter, we perceive that we did unintentionally misrepresent him about the wooden "vault," but our main objection, to the employment of wood in a monumental chapel, remains. If, with with all our modern resources in construction and materials, we cannot devise a stone vaulted roof which will be waterproof without a wooden bonnet over it, we ought to be ashamed of ourselves.

PIPES *v.* FAÇADES.

SIR,—In anticipation of the coming Health Exhibition, I venture to ask if architects and "sanitary engineers" can do nothing to prevent the disfiguration of so many of our best buildings by the affixing to them of ventilation-pipes of the most pronounced character? The pipes, led directly out from lavatories and closets into the equally prominent vertical soil-pipes, have long been a repulsive eyesore, but this evil is now increased by the new fashion of ventilating the drains of each house by means of the lead or zinc tubes, which the working plumber recklessly affixes to the most ornate architecture, and carries up on high to compete with the terrific abortions which the "smoke doctor" erects as the crowning glories of metropolitan architecture.

I say nothing against the *utility* of the contrivances, but I protest loudly against the supreme disregard of the most elementary æsthetic teachings, by the way in which these sanitary needs are supplied. It is surely a proof of bad construction, or probably bad design, when a chimney, *professedly complete for its function*, smokes so desperately as to necessitate two or three yards of straight or wondrously zig-zag tubing, terminated by a mysterious whirling cap being stuck upon it, no matter to what order of architecture the chimney may belong.

Need it be urged again, that every architect *ought* to study the subjects of heating and ventilation, and then, having regard to the surroundings of the buildings, design his chimneys so as to carry clearly away the little smoke which his improved fire-grates may generate? Or, in the case of badly-constructed old buildings, if a lengthened flue be necessary, it ought to be provided according to fitting architectural design in a suitable material.

As to the ventilation of drains, if the public drains are not ventilated as they should be by the authorities, by means of a furnace and shaft, then the architect should provide proper channels easily accessible, in which to place the pipes; but where this cannot be done, it might be possible, in some way, to disguise them, or hide them away in an out-of-sight angle.

It is a standing reproach to our private and professional taste that the owners of property should permit, and the designers of these contrivances perpetuate, such outrages on the canons of good taste and beauty, and we look to the teachings and practice of our professional architects to counteract this fast-spreading evil.

BELSIZE.

* History of Architecture in all Countries, vol. ii., p. 177.

CARPENTRY EXHIBITION.

SIR,—The letter in your issue of the 16th inst., signed "Henry Dunkley," raises quite a different point from that in his first letter, and my answer was only in allusion to his complaint of the value of the prizes offered in our exhibition.

I have not the time, and entirely decline, to discuss his present charges. It is not my province to defend the action of my own or the other City guilds, but I would only say that Mr. Dunkley is evidently quite unaware of the large amount of good work which has been done by them for many years.

This exhibition entails a very large amount of correspondence upon me, a considerable portion of which is with the class of artisans whose interest the companies earnestly desire to promote, and I am happy to say that, judging from their letters to me, they view the matter in a very different light from Mr. Dunkley, and it is for him to consider whether he chooses to exhibit.

So far as I am concerned, this must end the correspondence.

STANTON WM. PRESTON.

Carpenters' Hall, London Wall, Feb. 18.

"IRON UNDER TEST."

SIR,—The article in your last issue on "Iron under Test" contains, I think, a misapprehension. The cause of the difference in the percentage of ultimate extension is that at and near the point of fracture of a test piece the sectional area gradually diminishes, thus confining the extension (after the diminishing in sectional area becomes perceptible) to within a short distance of the point of fracture. Although I am not practically acquainted with testing, I believe that whether the test piece is long or short, the length of the part which exhibits this diminution in area is approximately constant. Hence the stretching may, for one part of the test, be distributed over the whole piece, but as soon as drawing down begins, the stretching will be localised, thus vitiating percentage results. As I understand your report of Mr. Hackney's paper, the thing to which he called attention was that the percentage of stretching in pieces having different ratios of length to sectional area was not a measure of ductility. This would not affect the breaking strain.

J. W. C. A.

MURAL PAINTINGS.

SIR,—Will you allow me to state with reference to the process of producing permanent mural paintings, which was the subject of my paper at the Society of Arts last week, that I shall be very happy, as M. Keim's representative in this country, to give artists or others who may be interested in it every facility for making a practical acquaintance with the method.

J. A. RIVINGTON.

32, *Eardley-crescent, Earl's-court, S.W.*

THE NEW STREET IN THE CITY.

SIR,—The widening of Eastcheap and Tower-street with the spur leading into Trinity-square has formed a noble street, but if this street is to be of any service to the east end of the town it should be continued to the Minories, and thence to Alie-street, so as to form a junction with Leman-street and the Commercial-road.

If this were done it would form a continuous street from these points through the City to the West End, and thus relieve Whitechapel, Aldgate, and Fenchurch streets of the traffic which now passes through them to go to London Bridge, Cannon-street, and Upper Thames-street.

Aldgate and Fenchurch streets are totally inadequate to the present traffic, and on three days a week Whitechapel and the adjacent streets are blocked up with hay-carts. These facts render the question well worthy of the attention of the authorities.

A. & H.

*** Want of space this week compels us to defer several important letters.

COMPETITIONS.

Llanelly Hospital.—The Governors of the Llanelly Hospital advertised for plans for a new hospital in November last, to which about twenty-seven architects responded. The Governors selected a few designs out of the number for reference, the referee being Mr. Salter, F.R.I.B.A., of Woburn-place. He placed the designs in the following order of merit:—1. Mr. E. M. Bruce Vaughan, Cardiff; 2. Messrs. Wilson & Dyer, London and Swansea; 3. Messrs. James, Seward, & Thomas, Cardiff. He recommended Mr. Bruce Vaughan to be employed as architect, and the committee, at their meeting on Monday last, gave him instructions to proceed with the work.

St. Philip's Church, Southport.—We are informed that out of upwards of fifty-three sets of plans submitted in competition for St. Philip's Church, Southport, Mr. R. F. Lobson's, of Manchester, were awarded the first premium of 25*l.*; and those of Messrs. Barry & Son, of Liverpool, the second premium of 10*l.*

Books.

Manchester Ship Canal. Description of the Project now before Parliament, with Maps. Published by the Provisional Committee. Manchester. 1884.

ALTHOUGH the project of a Ship Canal from Manchester to the sea has now been for more than eighteen months before the public, the inhabitants of London and of the southern and western districts of England have but little acquaintance with the details of a scheme which has excited extraordinary interest in the centre of the manufacturing districts. No proof of the different views of local, and even of national, interests which are habitually taken by the inhabitants of different districts of our island could be suggested as more striking than that which may be afforded by a trip from London to Manchester. What in the Metropolis is only indifferently regarded, if spoken of at all, as one of the railway or canal enterprises for which Bills are deposited for the Session of 1884, is regarded by the great mass of the manufacturers and merchants of the wide district of which Manchester is the capital as a question affecting the very existence of an enormous mass of industry. The population now packed within a radius of forty-five miles of Manchester amounted to more than 7,000,000 souls in 1881. And, rightly or wrongly, the great portion of the working population of this part of England is giving practical proof that they believe their welfare to be closely bound up with the opening of the cheapest possible route from Manchester to the sea.

In the *Builder* for the 24th of June, and in that for the 8th of July, 1882, will be found an account of the general features of the communications now existing between Manchester and the sea, together with a summary of the objections against the original scheme of a canal without locks from the former city to the ocean. As to this, the Provisional Committee saw reason to change the first project; and in November, 1882, they deposited plans for a semi-tidal canal, with three sets of locks. Some difficulty arose as to the best mode of dealing with the improvements in the tidal estuary of the Mersey, which formed an essential part of any scheme for admitting large vessels to Manchester; and although the promoters of the scheme laid before the House of Commons Committee the formal support of the Conservators of the Mersey, one of the most influential public authorities in the kingdom, it was held that the technical requirements of the Standing Order of Parliament had not been fulfilled, and the Bill, having been much cut down in the Commons, was finally lost in the Lords. In coming a second time before Parliament, taught by experience, the promoters have not only supplied six or seven gaps that were pointed out in their former scheme, but have taken measures to inform the public of the main features of the enterprise, commercial, financial, and engineering, by the issue of a clear and well-written pamphlet.

The works of the undertaking comprise the canal from Manchester to Runcorn, the works in the estuary, the docks, and the railway diversions and branches. The total length of the canal proper is 21¼ miles, which is divided

by four sets of locks and sluices into five pounds. The width of the canal at bottom is 120 ft., the depth 26 ft. This is the depth of the Suez canal; and the width is 24 ft. less than that specified in the original contract for the Suez canal, and 48 ft. more than the actual minimum width of the same. The locks will be three in each set, one 550 ft. by 60 ft., one 300 ft. by 40 ft. and one 100 ft. by 20 ft. The fall varies from 8 ft. to 15 ft., amounting to 50 ft. 6 in. in all. Gaugings of the water flow show that there is ample, in the dryest season, to pass 175 vessels, of an aggregate tonnage of more than 10,000 tons, per day; the actual traffic of the Suez canal being under ten vessels per day. At Barton the ship canal will be connected by hydraulic lifts with the Bridgewater canal. There will be swing-bridges at Barton, Warburton, Latchford, and Warrington, to be worked by hydraulic power.

The area of the Manchester dock will be 67 acres. At Warrington the present channel of the Mersey will be converted into a dock of 20 acres. There will also be a coal-loading basin at Partington. The five railways that cross the canal will be carried over high-level bridges, to each of which the rise is on an incline of 1 in 132.

A channel through the estuary of the Mersey is to be maintained by means of training walls for a distance of ten miles, from Runcorn to Garston. The depth will be 12 ft. at low water spring tides, which gives 40 ft. at high-water spring tides. At neap tides the corresponding depths are 20 ft. and 32 ft. The width will be 300 ft. at Runcorn, gradually increasing to 1,000 ft. at Garston.

The estimate is as follows:—

Canal	£3,920,171
Estuary works	1,390,419
Docks	1,121,262
Railways	456,172
Roads	16,162
Total	£6,904,186

This includes an allowance of 10 per cent. for contingencies over fair contractors' prices. It is estimated that the canal may be completed in four years.

On a traffic of 10,000 tons of cargo per day, (which is only a third of that of the Suez Canal,) a charge of 5s. per ton of goods would yield a revenue of 750,000*l.* per annum. On this, 15 per cent. is allowed for working expenses, amounting to 112,500*l.*, or 3,600*l.* per mile. The working costs of the Suez Canal for 1882, deducting social charges and administration, were only 2,654*l.* per mile (see *Builder* for Oct. 20, 1883) or a little under 9d. per ton gross of shipping for the entire transit. The figures given in the pamphlet show a net return of nearly 7 per cent. on eight millions of share capital, plus 2 per cent. on two millions of loan capital. But if we take the traffic and cost of working of the Suez Canal as a guide, it would seem that the estimate of the promoters as to income is far under the mark. Seven millions of tons, which is under the actual Suez traffic, at a penny per ton per mile, or say 2s. 8d. for the distance from Garston to Manchester, amounts to 933,000*l.* per annum. Fifteen per cent. on this (being one and a half times the cost of the Suez working expenses) comes to 140,000*l.*, leaving a net profit of 793,000*l.*, or 7·93 per cent. on 10,000,000*l.* of capital. Thus the charge of 5s. per ton can only be regarded as provisional, until the growth of traffic is such as to allow a considerable reduction.

In future editions of this useful pamphlet we hope that the last paragraph on p. 48 will be omitted. It is the only thing that we have found wrong in the book; and it very likely was taken from what was regarded as good authority. But as it stands, it may discredit the more accurate statements. It is not the case that the capital of 24,000,000*l.* for the Panama Canal was over subscribed in a short time. The estimate for that canal, made by the engineer of the Suez Canal, was 42,800,000*l.* The total capital, of which half has been called up, was fixed at 12,000,000*l.* The possible revenue, at the mileage rate of the Suez Canal, according to the calculations of Mr. Nimmo, the chief of the Bureau of Statistics at Washington, is about 406,000*l.*,—supposing the line to be made. It is better, in dealing with a serious matter like the Manchester Canal, to steer clear of imaginary statements.

MEETINGS.

SATURDAY, FEB. 23.

Architectural Association.—Visit to the Albert Exhibition Palace, Battersea Park. 3 p.m.

London Sanitary Protection Association.—Annual Meeting. 4 p.m.

MONDAY, FEB. 25.

Royal Academy. Mr. G. Aitchison, A.R.A., "On Colour applied inside Buildings: Stained Glass and Painting." 8 p.m.

Society of Arts.—Mr. R. W. Edis, F.S.A., on "The Sanitation, Lighting, Heating, and Ventilation of Town Houses." (Cantor Lecture.) 8 p.m.

Surveyors' Institution.—Mr. R. Woolley on "Agrimensores." 8 p.m.

London Institution.—Dr. E. B. Tylor, F.R.S., on "The Three Sources of History,—Records, Monuments, and Social Laws." 5 p.m.

TUESDAY, FEB. 26.

Builders' Clerks' Benevolent Institution.—Annual General Meeting. 7 p.m.

Institution of Civil Engineers.—Mr. Sydney W. Barnaby on "Hydraulic Propulsion." 8 p.m.

Royal Institution.—Dr. Archibald Geikie, F.R.S., on "The Origin of the Scenery of the British Isles." 3 p.m.

WEDNESDAY, FEB. 27.

Civil and Mechanical Engineers' Society.—Mr. C. H. Cooper, A.-M.I.C.E., on "Chalk Water." 7 p.m.

Society of Arts.—Mr. G. Swinburne King on "Internal Corrosion and Scale in Steam Boilers." 8 p.m.

THURSDAY, FEB. 28.

Royal Academy.—Prof. C. T. Newton on "The Monuments of Ancient Art which have been discovered since 1850." 8 p.m.

Society of Antiquaries.—Mr. A. G. Hill, F.S.A., on "The Ecclesiology and Architecture of some Towns in Mecklenburg and Pomerania." 8.30 p.m.

Society for the Encouragement of the Fine Arts.—Mr. C. Pfoundes on "The System and the Meaning of the Art of Old Japan." (Sir P. Cunliffe Owen in the chair.) 8 p.m.

Society of Engineers.—Mr. J. W. Wilson, jun., on "The Work of the Pattern-shop and Foundry." 8 p.m.

Society of Telegraph Engineers and Electricians.—(1) Mr. B. W. M. Mordey "On Some Prejudicial Action in Dynamo-machines." (2). Prof. G. Forbes "On the Effects of Induction in Alternate Current Machines." 8 p.m.

Society of Arts (Applied Chemistry and Physics Section).—Prof. Silvanus P. Thompson on "Recent Progress in Dynamo-Electric Machinery." 8 p.m.

Parkes Museum of Hygiene.—(1). Dr. H. C. Bartlett on "Principles involved in the Purification of the Air in Living Rooms, Sick Wards, &c." (2). Dr. Richard Neale on "How to secure Pure Air, independent of Ventilation, without Draught, and of a regulated Temperature." 8 p.m.

Royal Institution.—Professor Tyndall on "The Older Electricity: its Phenomena and Investigators." 3 p.m.

FRIDAY, FEB. 29.

Architectural Association.—Mr. F. E. Eales on "The Arrangement of Buildings in Flats." 7.30 p.m.

Royal Institution.—Prof. D. E. Hughes, F.R.S., on "The Theory of Magnetism." 9 p.m.

Miscellanea.

The Competition for the Victor Emmanuel Monument, Rome.—At the second competition for this monument, to which we referred in the *Builder* of January 26, the design of Signori Sacconi, of Rome, and Manfredi, of Piacenza, and Herr Schmitz, of Düsseldorf, have been awarded premiums of 10,000 lire each. The three successful competitors have also received each 5,000 lire for preparing the clay models. After the execution of the latter, the artist whose work is placed first will be charged with the execution of the monument.

The Metropolitan Board of Works have just approved the plans and specifications and sanctioned the erection of two large blocks of artisans' dwellings on vacant land abutting on Gun and Flint-streets, Southwark. When completed the dwellings will give living and sanitary accommodations for nearly thirty families. The designs were prepared by Messrs. Careless & Walker, architects, of Bloomsbury. Messrs. Nathan Bros., of Sutton, are the builders.

The Winner of the Godwin Bursary this year is Mr. Frederick Richard Farrow (not *Farrell*, as erroneously stated in our report of the proceedings of the Royal Institute of British Architects a fortnight ago, p. 211). The number of candidates for the Bursary was *six*, not thirty-six.

Edinburgh.—The Abbey Parish Church was re-opened on Sunday after undergoing considerable renovation and decoration. The most of the work has been bestowed on the wall behind the pulpit, the centre of which is occupied by the illuminated organ, placed in a large arch. On each side of this arch a painted reredos has been introduced, showing in flat ornament an arrangement of pointed arches, terminating in freely designed Early English foliage. The decoration of this wall is completed by a scroll, containing a text, round the large arch, while the remaining walls are treated in a simple manner, showing borders round the windows, and a running scroll at top of the wood lining. The whole decoration is in the pure Early Gothic style, and the prevailing colours are salmon-colour, brown, and red, and here and there a soft blue. The work is by George Dobie & Son, of George-street, Edinburgh. A boundary wall is being built round the church, and operations are going on for the introduction of a bell of 10¼ cwt. into the belfry, and a four-dial clock in the tower. The bell is to be by Warner, of London, and the clock by Ritchie, of Edinburgh.

General Engineering Construction.—The first of a course of lectures on "General Engineering Construction," by Mr. J. W. Wilson, M.I.C.E., &c., Principal of the Crystal Palace School of Practical Engineering, was delivered on the evening of February 14, in the reading-room of the Society of Engineers, Victoria-street, Westminster; Mr. Arthur Rigg, C.E., president, in the chair. The lecturer commenced by giving some general advice to young engineering students as to the sort of information they should seek, and to what they should devote their energies. Then, impressing upon them the great importance of a thorough knowledge of the obtaining and manipulation of materials, he touched upon timber and forestry, upon the values of fuels, upon the preparation of cast-iron, wrought-iron, and steel, upon the working of native stone, and upon the covering of roofs. The lecturer concluded by again impressing upon his audience the great importance of investigating these and similar matters in a practical manner for themselves.

Electrical Engineering.—The sixth of the series of lectures on "Electrical Engineering," by Mr. John C. Fell, was delivered on the evening of February 18, in the reading-room of the Society of Engineers, 6, Westminster Chambers; Mr. Arthur Rigg, president, in the chair. Mr. Fell resumed his subject by the consideration of systems of incandescent electric lighting, giving examples of the best known forms of lamps, such as the Swan, the Gatehouse, and others. The laws of the development of heat and consequent light in filaments offering specific resistance to conduction were explained. The danger of disruption through excess of current was pointed out, and the necessity for an absence of oxygen in the atmosphere of the lamp surrounding the filament was explained. The modern improved methods adopted for the production of a vacuum in the lamps were shown by sketches, and some practical examples of safety junctions, lamps, &c., were exhibited.

The Westinghouse Safety Apparatus for Crossings.—The crossing of the Philadelphia and Reading and Lehigh Valley Railroads, two miles west of Bound Brook, New Jersey, has been fitted with interlocking signals and derailing switches upon the Westinghouse electro-hydro-pneumatic system, the movements of the switches and signals being effected by compressed air controlled by electricity from the signal cabin. This arrangement allows a train having the right of way to pass the crossing at full speed, during which passage it automatically locks open the derailing switches on the intersecting track, thereby preventing all possibility of collision. The apparatus has been erected by the Union Switch and Signal Company, of Pittsburgh, and came into operation on January 6. This is stated to be the first apparatus of the kind ever erected, and has excited much interest among American railway men.—*Iron.*

Newcastle.—The Newcastle Asylum visiting justices have appointed Arthur B. Plummer, architect, their architect for the intended extensive additions to Coxlodge Asylum. Mr. Plummer is also appointed architect for the intended Church Institute at St. Peter's Quay, for the Rev. J. Sunter, B.A., the first portion of which is to be built this year.

The "Otto" Gas Engine.—Messrs. Crossley Bros., Limited, of Manchester, have recently added an important improvement to their gas-engine. This consists of a "Self-starting Apparatus," by means of which the engine can be put in motion by simply opening a valve. The apparatus consists of a small receiver into which the engine exhausts for a very short period of its stroke the burned gases which result from the ignition of the charge in the cylinder. These gases fill the receiver, and in the course of half a minute raise a pressure in it nearly corresponding to the pressure in the cylinder during the moment of ignition. These stored burned gases are admitted again to the cylinder at the moment of starting by a very simple piece of mechanism, and thus puts the engine in motion in much the same way as steam moves a steam-engine, thus saving the trouble of pulling the wheel round to get in the first charges.

The Keighley Timber and Saw-mills Company.—This company is starting what may be called an experiment on a large scale of some importance; an endeavour to prove practically that by the aid of machinery, division of labour, and close connexion with a railway system, joinery can be produced at a cost enabling the company to conduct a profitable business at the same scale of prices as those of the large Swedish and American manufacturers, whose work has been underselling English joinery so much. This is a spirited attempt to meet foreign competition, and if it succeeds, it may provide profitable employment both for English capital and English labour. Particulars as to the company will be found elsewhere.

London Commercial Deposit Building Society.—The twentieth annual meeting of this society is announced to take place at the Inns of Court Hotel, High Holborn, on Wednesday, March 5th. The directors have declared a dividend of 5½ per cent. Messrs. W. Hurran, chairman, E. T. Davy, C. H. F. Lewes, and W. F. Potter, the retiring directors, offer themselves for re-election. Messrs. Hurran and Potter have been connected with the society since its first formation in 1863.

TENDERS.

For new roads, sewers, &c., on the British Land Company's Estate, at Putney. Mr. Henry B. Michell, surveyor:—

J. Bloomfield, Tottenham	£1,660 0 0
F. W. Keeble, Regent's-park	1,629 0 0
J. Jackson, Leyton	1,333 0 0
C. Kirlingback, Camden Town	1,300 0 0
W. Harris, Camberwell	1,275 0 0
Nowell & Robson, Kensington	1,270 0 0
E. Wilson, Walthamstow	1,133 0 0
J. Pizzey, Hornsey	1,084 0 0
Peill & Sons, Bromley, Kent*	1,049 0 0

* Accepted.

For building new schools for the Guardians of the Poor of the Edmonton Union. Mr. T. E. Knightley, architect. Quantities by Messrs. Batterbury & Huxley and Mr. Edward Clark:—

		Extra for Arlsey facing bricks.
Bentley	£64,915	£2,308
Tongue	63,351	1,538
Hack	62,994	1,530
Downs	61,332	1,332
Hobbs	61,000	1,538
Shurmur	58,365	769
Hart	57,354	1,489
Greenwood	57,259	1,739
Nightingale	56,545	879
Holliday	56,397	1,635
Brass	54,283	1,370
Wall (accepted)	52,980	769
Foster & Dicksee	52,620	1,153
Howell	51,765	1,700

For the erection of five stables and coachhouses, with roadway to the Devonport-road, at the rear of five shops, in the Uxbridge-road, Shepherd's-bush, for Mr. Miles Gawthorp. Mr. Richard Tomlinson, architect. Quantities supplied by architect:—

G. Lyford (accepted)	£925 0 0

For additions and repairs to residence at Orpington. Mr. G. St. Pierre Harris, architect:—

Wood	£1,493 0 0
Otway	1,339 0 0
Treadwell	1,335 0 0
W. & F. Croaker	1,269 0 0

For additions and repairs to house at Orpington. Mr. G. St. Pierre Harris, architect:—

Taylor & Son (accepted)	£153 0 0

[No competition.]

For additions to a house at Keston. Mr. G. St. Pierre Harris, architect:—

Wood	£989 0 0
Otway	943 0 0
Crossley*	893 0 0

* Accepted, subject to modification.

For Fire Station, Sheds, &c., Hornsey, for the Hornsey Local Board. Mr. T. de Courcy Meade, engineer and surveyor:—

Colls & Sons, Moorgate-street	£3,100 0 0
B. E. Nightingale, Lambeth	2,885 0 0
Gibbs & Imber, Highgate	3,699 0 0
J. W. Dixon, South-grove, Highgate	2,729 6 2
J. & J. Greenwood, Bermondsey	2,950 0 0
Staines & Son, Great Eastern-street	2,778 0 0
Mattock Bros., Finsbury Park	2,977 0 0
W. Goodman, Holloway	2,888 0 0
John Tillbrook, Crouch End-hill, N.	2,709 19 6
Wilkinson Bros., Finsbury Park	2,995 0 0
C. F. Kearley, Kensington	2,790 0 0
Dunmore, Crouch End, N.	3,208 0 0
Pyle & Co., Herne Hill	2,635 0 0
Kerry & Son, High-street, Highgate	3,267 0 0
James Harper, 98, Amhurst-road, road, Hackney (accepted)	2,578 0 0

For making and draining, with sewer and surface water drains complete, portions of Berkeley and Shanklin roads, on the Crouch Hall estate, Crouch End, for the Imperial Property Investment Company, Limited. Mr. G. H. L. Stephenson, surveyor:—

	* 1st Estimate.	† 2nd Estimate
Bell	£1,417	£1,250
Dunmore	1,314	1,277
Walker	1,195	1,109
Pizzey	1,191	1,105
Wilson	1,150	1,050
Adams (accepted)	1,089	977

* If roads made up with brick rubbish and stone ballast.
† If roads made up with dust-heap pickings and burnt ballast.

For alterations at the Pines, Epsom. Mr. H. D. Church architect:—

Akerman	£515 13 0
Tenson	383 15 6
Shurmer	378 0 0
Robbins	358 0 0
Godden	319 0 0

For additions and sanitary alterations to Sussex County Asylum. Mr. Henry Card, county surveyor:—

Lockyer, Brighton	£3,954 0 0
Cheesman, Brighton	3,480 0 0
Smith & Co., Worthing	3,330 0 0
Knight, Cuckfield	3,184 0 0
Box, Ardingly	3,089 0 0
Norman, Burgess-hill (accepted)	2,895 0 0

For St. Paul's Vicarage, New Swindon. Mr. John Bevan, architect, Bristol. Quantities supplied:—

R. Wilkins & Sons, Bristol	£1,590 0 0
W. Church, Bristol	1,490 0 0
W. Cowlin & Son, Bristol	1,459 0 0
Stephens & Bastow, Bristol	1,450 0 0
H. H. Forse, Bristol	1,445 0 0
T. Barrett, Swindon	1,390 0 0
C. J. King & Son, Bitton	1,362 0 0
E. & T. Hatherly, Bristol	1,350 0 0
E. C. Howell & Son, London and Bristol	1,336 0 0
W. Jones, Gloucester	1,320 0 0
J. Wheeler, Wantage	1,275 13 6
G. Wiltshire, Swindon (accepted)	1,236 0 0

For the erection of new schools and vestries in connection with the Wesleyan Church, Blackheath. Messrs. Dunk & Geden, architects, Leadenhall-street:—

Otway	£3,042 0 0
Dobson	2,980 0 0
Lawrance & Sons	2,818 0 0
Rider & Son	2,818 0 0
Smith & Sons	2,735 0 0
Outhwaite	2,694 0 0
Morter	2,687 0 0
Staines & Son	2,672 0 0
Greenwood	2,669 0 0
Jerrard	2,627 0 0
Chafen	2,556 0 0
Grubb	2,470 0 0
Tongue	2,450 0 0
Kennard Bros. (accepted)	2,263 0 0

For the erection of school and class-rooms for the Trustees of Romford Congregational Church. Mr. E. C. Allam, architect, Romford. Quantities supplied:—

J. Abrahams, Romford	£1,250 0 0
Staines & Son, Great Eastern-street	1,148 0 0
J. E. Dowsing, Romford	1,086 0 0
A. Davey, Romford	1,030 0 0
G. Death, Romford	1,015 0 0
W. Wood, Chelmsford (accepted) *	1,010 0 0

[Architect's estimate, 1,011*l.*]
* Amended estimate to include additional work, 1,160*l.*

For the erection of a tobacco factory at the rear of No. 143, High-street, Whitechapel, for Mr. E. Toplis. Mr. John Hudson, architect, 80, Leman-street:—

T. Norton & Son, Stratford	£1,482 0 0
T. Little, Whitechapel	1,397 0 0
A. Eaton, Whitechapel	1,395 0 0
C. P. Roberts, Canonbury	1,368 0 0
W. Marriage, Croydon	1,240 0 0

For building an addition to the Shoeburyness Tavern, Shoeburyness, Essex. Mr. John Hudson, architect:—

G. Ventris	£280 0 0
J. Alp	274 5 0
J. & H. Cocks	248 0 0
S. Norden	227 0 0
Baker & Wiseman (accepted)	223 9 0

For alterations and additions to Silverlands, Chertsey, for Mr. F. A. Hankey. Mr. George A. Dunnage, architect, 5, John-street, Adelphi. Quantities by Messrs. J. & A. E. Bull, 35, Craven-street:—

Knight & Sons, Chertsey (accepted)	£9,143

For works at Harvest Home, Oakington. Mr. Frank Waters, architect, Cambridge. Quantities supplied:—

Christmas, Histon	£435 0 0
Hammond, Longstanton	437 0 0

For alterations and additions to the Board Schools, Bynes-road, for the Croydon School Board. Quantities by Mr. Robert Ridge, Surveyor to the Board:—

Legg	£6,900 0 0
Maides & Harper	6,670 0 0
Ward	5,988 0 0
J. & C. Bowyer	5,951 0 0
Bullock	5,889 0 0
Taylor	5,720 0 0
Loe & Son	5,638 0 0
Coles	5,577 0 0
Holt	5,575 0 0
Smith & Bulled	5,422 0 0
Pearson	5,400 0 0
Sedgwick	5,229 0 0
Smith & Son	5,196 0 0
Marriage	4,950 0 0

For erecting the Langford-road schools, for the School Board for London. Mr. E. R. Robson, F.S.A., architect:—

Shillitoe	£14,509 0 0
Wood	13,910 0 0
Howell	13,063 0 0
Johnson	12,795 0 0
Bangs	12,751 0 0
Turtle & Appleton	12,748 0 0
Lathey Bros.	12,672 0 0
Smith & Son	12,670 0 0
Kirk & Randall	12,540 0 0
Reading	12,533 0 0
Oldrey	12,527 0 0
Brass	12,416 0 0
Jerrard	12,333 0 0
Stimpson	12,180 0 0
Holloway	12,119 0 0
Shurmur	12,090 0 0
Grover	12,038 0 0
Downs	11,955 0 0
C. Wall	11,820 0 0

For alterations to Mr. Gorringe's premises, Brewer-street, Pimlico. Mr. J. T. Walford, architect:—

W. Scrivener & Co. (no time)	£1,698 0 0
Hall, Beddall, & Co. (1st April)	1,294 0 0
C. Fish, Prestige, & Co. (two months)	1,159 0 0
Wilkes Bros. (two months)	1,076 0 0

For the erection of new schools at Spark Hill, Yardley. Mr. W. Hawley Lloyd, architect, 79, Colmore-row, Birmingham:—

	Schools.	Extra Class-rooms.
J. Moffatt	£1,616 0 0	£56 0 0
T. Mills	1,606 14 0	70 0 0
W. Sapcote & Sons	1,549 0 0	53 0 0
T. Hughes	1,536 0 0	77 16 0
Whitehouse & Jones	1,469 0 0	60 15 0
J. Rice	1,456 8 11	64 15 10
Bragg Bros.	1,454 0 0	57 0 0
W. Trow & Sons	1,448 9 9	56 14 10
F. J. Briley	1,443 0 0	56 0 0
J. Smith & Sons	1,398 0 0	54 0 0
T. Smith (accepted)	1,299 0 0	47 10 0

For works to roofs of mansion at Dropmore, near Maidenhead, for Lady Louisa Fortescue. Mr. G. B. Mayo, architect:—

		Allowance for Old Materials.
W. Watson, Ascot	£847 13 0	£135
Burman & Sons, Enfield	785 0 0	85
North & Son, Southwark	790 0 0	100
J. Boulter, Slough	743 0 0	65
W. Harbrow, Brixton	717 7 0	77
W. H. Simonds, Reading	720 0 0	120
G. Almond, Burnham	634 7 6	45
J. Deverill, Slough	645 0 0	75
F. Taylor, Uxbridge	634 0 0	76
W. Woodbridge, Maidenhead*	615 0 0	80
L. A. Williams, Beaconsfield	569 9 3	50

* Accepted.

Accepted for sundry alterations and repairs for Messrs. Bowring and Small, 22, Baker-street. Mr. J. W. Morris, architect, Gracechurch Street-buildings:—

D. D. & A. Brown, Camberwell-green	£600 0 0

[No competition.]

For retaining walls in buttress and arcade work, for intramural interments in vaults and catacombs, at Nottingham Church Cemetery. Mr. Fredk. Jackson, C.E., architect, Nottingham:—

Lynam & Kidd, Nottingham	£1,925 0 0
Bradley & Barker, Nottingham	1,865 0 0
Meats Bros., Nottingham	1,770 0 0
J. Hodson, Nottingham	1,471 0 0
T. Beck, Matlock	1,308 0 0
T. Smart, Nottingham	1,282 0 0
S. & J. Cargill, Nottingham	1,250 0 0
Foster & Barry (accepted)	1,127 0 0

[Architect's estimate, 1,233*l.* 10*s.*]

For additions, Cefnfeas, Rhayader, Radnorshire. Mr. Stephen W. Williams, County Surveyor:—

D. B. Hamer, Rhayader	£497 14 0
J. Davies, Hereford	468 0 0
J. Williams, Knighton	467 7 0
Treasure & Son, Salop (accepted)	463 0 0
T. P. Evans, Rhayader	459 0 0
W. Bowers & Co., Hereford	419 0 0
G. Dore, Rhayader	425 0 0
E. Davies, Newtown	376 0 0

For sewering, levelling and laying foundations in Gladstone-road, and the sewering of Granville-road, in the township of Urmston, for the Barton-upon-Irwell Sanitary Authority. Quantities supplied by the engineer, Mr. John Price, Assoc. M. Inst. C.E.:—

Snape & Sons, Eccles	£605 4 6
J. Randall, Weaste	602 6 0
J. Oakes, Kearsley	585 4 10
E. Bird, Chorlton	561 0 0
G. Unsworth, Moss Side	546 14 6
M. Naylor, Hulme	533 4 3
T. Willan, Chorlton-on-Medlock	510 1 7
W. H. Worthington, Rusholme	474 6 3
W. Hamnett, Ashton	443 18 2
R. Lomax, Eccles (accepted)	438 14 0

[Engineer's estimate, £515.]

For proposed new building at the corner of St. Mary Axe and Great St. Helen's, for Mr. A. Kelday. Mr. T. Chatfield Clarke, architect:—

E. Conder	£9,035	0	0
J. & J. Greenwood	8,632	0	0
Colls & Sons	8,3?8	0	0
Holland & Hannen	8,212	0	0
M. Redman	8,184	0	0
Hall, Beddall, & Co.	7,985	0	0
Ashby Bros.	7,858	0	0
G. H. & A. Bywaters	7,763	0	0
Ashby & Horner	7,664	0	0
B. E. Nightingale	7,473	0	0
E. Lawrance & Sons	7,418	0	0

For completing houses at Ewelme, and for the formation of roads on building estate at Goring. Mr. J. S. Dodd, architect, Reading:—

Holly & Butler, Nettlebed	£695	0	0
Selby, Oxford	663	0	0
Brasher, Wallingford	649	0	0
Partlo, Tilehurst	654	0	0
Woodroffe, Reading	645	0	0
Dover, Oxford	640	0	0
Newberry, Reading (too late)	600	0	0
Weller, Wallingford	595	0	0
Cox, Henley-on-Thames	564	0	0
Buckle & Wheeler, Abingdon*	515	0	0

* Accepted.

For constructing new roads on the Goring Building Estate. Mr. J. S. Dodd, architect:—

F. Talbot, Caversham	£675	0	0

For artisans' dwellings, Boundary-street, Shoreditch, for Mr. James Reeves. Messrs. Thos. & Wm. Stone, architects, Great Winchester-street-buildings, London Wall:—

S. W. Hawkins	£3,740	0	0
J. Anley	3,727	0	0
J. H. Johnson	3,593	0	0
J. Howlett	3,350	0	0
F. G. Higgs	3,285	0	0
G. W. Beale	3,249	0	0
Jackson & Todd	3,184	0	0
Thomerson & Son	3,120	0	0
W. Goodman	2,888	0	0
J. E. Young	2,868	0	0
B. T. Wood	2,655	0	0
Steel Bros.	2,597	0	0
C. Forrest, Victoria Park-square*	2,486	0	0

* Accepted.

For the erection of additional stabling at Uxbridge-road, Shepherd's-bush, for the London General Omnibus Company, Limited, under the superintendence of Mr. G. T. Lanham. Quantities by Mr. A. J. Bolton:—

Williams, Son, & Wallington	£980	0	0
Lyford	907	0	0
Scharien & Williams	863	0	0
Scott	827	0	0
Priestly & Gurney	773	0	0
Higgs	760	0	0
Hack	749	0	0
Garrud	727	10	0
Howell & Son	726	0	0
Richens & Mount	721	0	0
Haynes	700	0	0
Parker	649	0	0
Aldridge & Jenvey	628	0	0

For proposed new Baptist Chapel and Schools in the Werter-road, Putney, for the Building Committee. Mr. John Johnson, architect, Queen Victoria-street. Quantities supplied by Mr. William H. Pipe:—

Bishop	£5,750	0	0
J. W. Falkner	5,657	0	0
Tarrant & Son	5,625	0	0
R. Conder	5,496	0	0
Higgs & Hill	5,494	0	0
Stimpson & Co.	5,480	0	0
W. Johnson	5,396	0	0
Nightingale	5,300	0	0
Killby & Gayford	5,250	0	0
J. Smith & Co.	5,080	0	0
Allen & Son (accepted)	4,500	0	0
Hobson	4,462	0	0

For erecting and completing The Shakspeare, Waterloo-street, for Messrs. Truman, Hanbury, & Buxton. Mr. J. C. Reynolds, architect. Quantities not supplied:—

Goad	£929	0	0
Shurmur	927	0	0
D. D. & A. Brown	890	0	0
W. Smith	796	0	0
T. Smith	765	0	0
Parker (accepted)	695	0	0

For alterations and additions to business premises, High-street, Bedford, for Mr. E. P. Rose. Messrs. Usher & Anthony, architects and surveyors:—

Knight & Boston	£2,518	0	0
S. Foster	2,430	0	0
T. Spencer	2,398	0	0
Warton & Walker, Bedford*	2,382	0	0

* Accepted.

For the erection of a pair of cottages and machine and engine houses, at Putnoe, Goldington, Bedford, for Mr. Chas. Pope. Messrs. Usher & Anthony, architects and Bedford, surveyors:—

G. Harrison, Bedford (accepted) £598 0 0

For the erection of dwelling-house in De Pary's-avenue, Bedford, for Mr. W. J. Robinson. Messrs. Usher & Anthony, architects and surveyors, Bedford:—

S. Foster, Kempston (accepted) £1,203 4 0

Accepted for public swimming and other baths at Forest-hill, for the Commissioners of Baths and Wash-houses for the Parish of Lewisham. Messrs. Wilson, Son, & Aldwinckle, architects, 2, East India-avenue, Leaden-hall-street:—

D. D. & A. Brown, Camberwell £7,177 0 0

Accepted for new class rooms at St. Mary's school, Leyland, near Preston. Mr. D. Grant, architect, Preston:—

Brickwork, stonework, plaster work, slating and flagging.
J. Simpson, Leyland.
Woodwork.
A. Tomlinson, Leyland.
Plumbing, &c.
J. Hesketh, Leyland.
Ironwork.
William Dryden, Preston.
Revolving school divisions.
J. Stones, Ulverston.
[Amount of contracts, £234.]

Special Notice.—Lists of tenders frequently reach us too late for insertion. They should be delivered at our office, 46, Catherine-street, Strand, W.C., not later than four p.m. on Thursdays.

TO CORRESPONDENTS.

W. M'K. (next week).—Severn Tunnel (we have made enquiries).—J. S. G. (under consideration) —T. L. P. (we decline to publish "tenders accepted" unless amounts are given).—J. F.—S. T.—H. S. A. (not required.—S. Brothers (no space.)

Correspondents should address the Editor, and *not* the Publisher, except in cases of busines.

All statements of facts, lists of tenders, &c. must be accompanied by the name and address of the sender, not necessarily for publication.

We are compelled to decline pointing out books and giving addresses.

NOTE.—The responsibility of signed articles, and papers read at public meetings, rests, of course, with the authors.

We cannot undertake to return rejected communications.

Letters or communications (beyond mere news-items) which have been duplicated for other journals, are NOT DESIRED.

PUBLISHER'S NOTICES.

THE INDEX and TITLE-PAGE for Volume XLV. (July to December, 1883) were given as a Supplement with the number of January 12, and A COLOURED TITLE-PAGE was issued the following week, in substitution for that published previously.

CLOTH CASES for Binding the Numbers are now ready, price 2s. 6d. each; also

READING-CASES (Cloth), with strings, to hold a Month's Numbers, price 2s. each; also

THE FORTY-FIFTH VOLUME of "The Builder" (bound), price Twelve Shillings and Sixpence.

SUBSCRIBERS' VOLUMES, on being sent to the Office, will be bound at a cost of 3s. 6d. each.

SPECIAL.—ALTERATIONS in STANDING ADVERTISEMENTS or ORDERS TO DISCONTINUE same, must reach the Office before TEN o'clock on WEDNESDAY mornings.

PERSONS Advertising in "The Builder," may have *Replies addressed to the Office*, 46, Catherine-street, Covent-garden, W.C. *free of charge*. Letters will be forwarded if addressed envelopes are sent, together with sufficient stamps to cover the postage.

TERMS OF SUBSCRIPTION.

"THE BUILDER" is supplied DIRECT from the Office to residents in any part of the United Kingdom at the rate of 19s. per annum, PREPAID. To countries within the Postal Union, 26s. per annum. Remittances payable to DOUGLAS FOURDRINIER, Publisher, 46, Catherine-street, W.C.

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DOUGLAS FOURDRINIER, Publisher,
Addressed to No. 46, Catherine-street, W.C.

Advertisements for the current week's issue must reach the Office before THREE o'clock p.m. on THURSDAY.

The Publisher cannot be responsible for DRAWINGS, TESTIMONIALS, &c. left at the Office in reply to Advertisements, and strongly recommends that of the latter COPIES ONLY should be sent.

Best Bath Stone.
WESTWOOD GROUND,
Box Ground, Combe Down,
Corsham Down,
And Farleigh Down.
RANDELL, SAUNDERS, & CO., Limited,
Corsham, Wilts. [ADVT.

SUMMER-DRIED
Corsham Down Stone
For Winter Use.
PICTOR & SONS, BOX, WILTS.
[ADVT.

Doulting Freestone and Ham Hill Stone of best quality, in blocks, or prepared ready for fixing. An inspection of the Doulting Quarries is respectfully solicited; and Architects and others are CAUTIONED against inferior stone. Prices, delivered to any part of the United Kingdom, given on application to CHARLES TRASK, Norton-sub-Hamdon, Ilminster, Somerset.—Agent, Mr. E. WILLIAMS, 73, Charlotte-street, Portland-place, W. [ADVT.

Doulting Freestone,
HAM HILL STONE,
BLUE LIAS LIME
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